4.01 DESIGN CRITERIA

1. General

All water distribution systems will comply with the requirements of the STANDARDS AND SPECIFICATIONS for water main and service line construction and may include special criteria established by the City for the overall hydraulics of the water utility system. The requirements set forth in the latest edition of the Denver Water Board Engineering Standards shall apply for information omitted in these STANDARDS AND SPECIFICATIONS. A preconstruction meeting shall be held with City Personnel prior to installation of any water utilities.

2. Water Distribution System Modeling

All new water distribution systems shall be modeled using Cybernet or Water CAD in accordance with criteria below. Output data showing all assumptions shall be submitted to the City for review.

3. Design Flow Requirements

The design of the water distribution system will be based on the following:

**UNIT WATER DEMANDS FOR FUTURE LAND AVERAGE DEMAND USE**

<table>
<thead>
<tr>
<th>Land Type</th>
<th>Avg. Demand</th>
<th>Max. Day Demand Factor to Avg. Demand</th>
<th>Peak Hour Factor to Max Day Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>145 gpcd</td>
<td>3.05</td>
<td>1.9</td>
</tr>
<tr>
<td>Commercial</td>
<td>1651 gpd/Acre</td>
<td>2.00</td>
<td>1.9</td>
</tr>
<tr>
<td>Industrial</td>
<td>1651 gpd/Acre</td>
<td>1.32</td>
<td>1.9</td>
</tr>
<tr>
<td>Park</td>
<td>3060 gpd/Acre</td>
<td>2.85</td>
<td>1.9</td>
</tr>
</tbody>
</table>

* gpcd=Gallons Per Capita/Day

Fire flows may be required to be calculated from more than one hydrant for a subject site, providing the hydrants used are directly connected to the water main for which the hydraulics are under review. Minimum fire flow rates shall be as noted below and shall be confirmed with the Fire District:

- Residential: 1,500 GPM
- Industrial/Commercial: 3,500 GPM
4. Operating Pressure Requirements

All areas will be designed to have a maximum static head of 290 ft. (125 psi) and a minimum static head of 100 ft. (43 psi). Distribution systems will also be designed to maintain a 20 psi minimum residual pressure during required fire flow and a 45 psi residual minimum during peak residential flows. Pressures for irrigation systems in proposed City parks shall meet the requirements of the Parks Department. The maximum pressure drop from static head to either fire flow or peak residential flow shall not exceed 30 psi.

Fire hydrant flow tests must be performed in order to determine exiting system pressures. Flow testing must be performed by licensed and insured testing companies and shall be accompanied by City Personnel when operating valves and hydrants on City water mains. The Fire District shall review flow data and comment on system pressures, and safety factors that are applied.

Water pressure and flow rates shall be compared with modeling results after construction of water mains have been completed. Hydrant flow testing shall be preformed for this purpose and test results shall be submitted to the City for approval.

5. Fire Hydrant Spacing

In residential areas, fire hydrants will be spaced a maximum of 500 ft. apart, as measured along street curb line and at an overall spacing that will not average less than one hydrant to 200,000 sq. ft. throughout an individual subdivision. Where blocks are over 800 ft. in length, intermediate hydrants will be placed in the center of the blocks. Fire hydrants will not be allowed at the ends of cul-de-sacs. Fire hydrants will be located in accordance with the Greater Brighton Fire Department.

In commercial and industrial areas, hydrants will be spaced not greater than 300 ft. apart.

6. Fire Service

The Developer will own and maintain all fire service lines extending from the valve on the City water main. Valves on newly constructed fire service lines will be located on the tee at the main line. Fire service lines are to be used exclusively for fire protection. Domestic water taps and/or irrigation taps will not be allowed on the fire service line unless written approval to do so is given by the City.

7. Distribution System Layout

Distribution mains and lateral lines will be located as indicated on the accepted plans. Lateral lines will normally be 8 in. diameter pipe. Where the length of the line between
CHAPTER FOUR    STANDARDS AND SPECIFICATIONS
WATER SUPPLY FACILITIES

branches is less than 300 ft. and in cul-de-sacs less than 300 ft. long (provided that a permanent blow-off or fire hydrant is installed at the dead end), 6 in. diameter pipe may be used. When approved by the City, 6 in. diameter lines may also be installed on permanent dead ends less than 300 ft. long when a permanent blow-off or fire hydrant is provided.

Dead ends will be minimized by looping whenever possible. Lines at ends of long cul-de-sacs shall be looped along lot lines to adjacent streets. Permanent dead ends shall be provided with a permanent blow-off or fire hydrant and temporary dead ends such as phasing within developments, shall have temporary blow-off (see Standard Details).

On new developments, mains and laterals shall be extended to the boundaries of Filings and completely across the frontage of individual lots.

8. Valve Spacing

Valves will be placed with a maximum spacing of 500 ft. in all distribution mains and lateral lines. Where City blocks exceed 600 ft. in length; an intermediate valve shall be installed. Valves will also be placed on each fire hydrant lateral and permanent blow-off.

Four-way and 3-way street intersections shall require at least 3 and 2 valves respectively, 1 located on each extended property line. For a succession of short blocks perpendicular to the direction for the distribution main and without residential or commercial services between, one or more intersection(s) may have the valve in that direction omitted, but must maintain the 50 ft. maximum spacing requirement.

Valves shall also be placed at each end of a line running through an easement on private property, on each side of a major creek or channel crossing, and on each side (at property lines extended) of a distribution line that provides service to a hospital, school or large industrial user.

9. Air and Vacuum Relief Valves

Combination air and vacuum relief valves shall be installed at each high point in all distribution mains and at high points of lateral lines as may be required by the City.

Air and Vacuum relief valves shall be installed in precast manholes or vaults fitted with air vents open to the atmosphere in accordance with the Standard Drawings.

10. Blow-off Valves

Provisions shall be included in the design to allow for the flushing of distribution mains and lateral lines at any low point in the system, or at any point noted on the accepted plans. The blow-off assembly shall be installed perpendicular to and on the downhill side of the main or line and shall drain to the nearest gutter line or drainage channel. The
blow-off assembly standpipe must have a threaded end to accept a fire hose coupling. The top of the standpipe shall be between four 4–6 in. below grade in accordance with the Standard Drawing.

Permanent dead ends shall be provided with a permanent blow-off or fire hydrant and temporary dead ends such as phasing within developments, shall have temporary blow-off (see Standard Details).

11. Pipe

All pipe used for distribution mains and lateral lines having a diameter of 12 in. or less may be either ductile iron pipe or PVC pipe. Distribution mains in excess of 12 in. in diameter through 36 in. in diameter shall be ductile iron pipe unless otherwise approved in writing by the City. In certain uses steel pipe may be approved in accordance with this section. Larger pipe sizes will be as directed by the City. The design engineer shall specify the pipe class as required for specific project conditions (see section 4.11.1).

12. Hydraulic Design

All pipes will be designed to have a maximum velocity of 10 ft. per second. New distribution mains and lateral lines shall be designed using the Hazen-Williams friction coefficients and maximum head losses noted below:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Hazen-Williams Friction Coeff.</th>
<th>Max. Head Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>6” – 12”</td>
<td>C-100</td>
<td>2’ per 1,000’</td>
</tr>
<tr>
<td>14” – 16”</td>
<td>C-100</td>
<td>2’ per 1,000’</td>
</tr>
<tr>
<td>20”</td>
<td>C-130</td>
<td>1.5’ per 1,000’</td>
</tr>
<tr>
<td>Over 20”</td>
<td>As directed by the City</td>
<td></td>
</tr>
</tbody>
</table>

13. Location (Typical)

Unless approved otherwise by the City, water mains shall be installed West or South of the centerline of the street beneath asphalt. Water mains shall not be located closer than 5 feet from the lip of the curb. Service connections will not be permitted to cross an arterial street.

Water mains will be located a minimum of 10 ft., horizontally, from existing or proposed sewer lines (centerline distance). A clear distance of 18 inches shall be maintained between water mains and other utility crossings. Where sewer lines cross water mains, the sewer pipe will be a minimum of 18 in., clear distance, below the water main. If this clear distance is not feasible, the water main must be lowered to at least 18 in. below the sewer line. The City Engineer must approve any deviation from this crossing design.
In all cases, where utilities are crossing within 18 in. of one another, compacted squeegee or flowfill shall be provided to preclude settling and/or failure of the higher pipe. If a water main cannot be lowered, an alternative will be to install water quality pressure pipe for the sewer with joints 10 ft. minimum each side of the crossing.

Where mains are installed in easements they will ordinarily be located in the center of the easement.

At street intersections, valves will be located at extension of the property lines. Fire hydrant gate valves will be placed near the main beneath asphalt. All fire hydrants will have a restrained connection directly to the tee off the main (see Standard Drawings).

In all instances, the water mains will extend to the boundary line of the property or subdivision served. A main serving one lot will extend the entire way across the frontage for that lot. Mains serving subdivision will extend to the center of boundary streets, to boundary lines or to the outside of paved areas as may be noted on the accepted plans.

14. Water Main Joint Deflection

The maximum allowable water main joint deflection for various pipe materials and lengths is listed in the following tables. If these offsets conflict with the pipe manufacturer’s recommendation, the more stringent requirement will apply.

**Polyvinyl (PVC) Pressure Pipe**

The maximum allowable pipe deflection for factory belled polyvinyl chloride pipe shall be as follows:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Maximum Offset</th>
<th>Minimum Radius of Curvature for 20’ Lengths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches</td>
<td>Inches</td>
<td>Feet</td>
</tr>
<tr>
<td>4”</td>
<td>24”</td>
<td>100’</td>
</tr>
<tr>
<td>6”</td>
<td>17”</td>
<td>145’</td>
</tr>
<tr>
<td>8”</td>
<td>12”</td>
<td>190’</td>
</tr>
<tr>
<td>10”</td>
<td>11”</td>
<td>230’</td>
</tr>
<tr>
<td>12”</td>
<td>9”</td>
<td>270’</td>
</tr>
</tbody>
</table>

**Ductile Iron Pipe (DIP)**

The maximum allowable pipe deflection for push-on type joint and mechanical-joint pipe shall be as follows:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Deflection Angle</th>
<th>Maximum Offset Inches</th>
<th>Minimum Radius of Curvature Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches</td>
<td>Degrees</td>
<td>18’ Length</td>
<td>20’ Length</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18’ Length</td>
<td>20’ Length</td>
</tr>
</tbody>
</table>
### Mechanical Type DIP Joint

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Deflection Angle</th>
<th>Maximum Offset Inches</th>
<th>Minimum Radius of Curvature Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches</td>
<td>Degrees</td>
<td>18' Length 20' Length</td>
<td>18' Length 20' Length</td>
</tr>
<tr>
<td>4”</td>
<td>4.0°</td>
<td>15” 17”</td>
<td>260’ 290’</td>
</tr>
<tr>
<td>6”</td>
<td>3.5°</td>
<td>13” 15”</td>
<td>295’ 330’</td>
</tr>
<tr>
<td>8”-12”</td>
<td>2.5°</td>
<td>9” 10”</td>
<td>415’ 460’</td>
</tr>
<tr>
<td>14”-24”</td>
<td>1.5</td>
<td>6” 6”</td>
<td>690’ 765’</td>
</tr>
</tbody>
</table>

15. Pipe Depth

All pipe will be installed with a minimum of 4 ft.-6 in. and maximum of 5 ft. of cover from finished grade of street to the top of the pipe barrel, unless approved otherwise.


All water main construction within the City and all water service line construction connecting to the City’s water mains will be done in accordance with these STANDARDS AND SPECIFICATIONS and the accepted plans and will apply to new water system construction as well as to repairs to existing facilities.

When special conditions are encountered or deviations from these STANDARDS AND SPECIFICATIONS are required by the City, and such changes are in the best interests of the City, the decision for the City will be final.

17. Permits Required

A public improvement permit will not be issued until the water main plans have been accepted by the City. A pre-construction meeting with the City Inspector and City, the Developer and the Contractor will be scheduled and completed prior to the commencement of any construction. The City will be notified 2 working days - (48) hours) before the planned construction is to begin.

18. Maintenance of Traffic

When street cuts are required for water main installation construction, conditions will be met so as to avoid interference with traffic. A Traffic Control Plan (TCP) must be
prepared in accordance with these Standards and Specifications and the Manual for Uniform Traffic Control Devices (MUTCD) and submitted to the City for approval prior to the commencement of construction.

4.02 UTILITY EXTENSION POLICY

No water and/or sanitary sewer utility service shall be extended to anyone or any area until such area is annexed into the City. To determine whether or not a property qualifies for sanitary sewer service, the property must lie within the current City limits.

4.03 STREET CUTS

The removal of pavement, sidewalks, driveways, or curb and gutter shall be performed in a neat and workmanlike manner. Pavement mix design, thickness and replacement shall conform to the requirements of Chapter 2.

4.04 PROTECTION OF EXISTING FACILITIES

The Contractor shall notify the electric and gas utility, telephone company, cable T.V., and all other interested parties prior to commencement of work and have their facilities staked and located in the field in order to ensure that there will not be interruptions of these services during progress of the work. Existing power lines, telephone lines, trees, shrubbery, fences, water mains and services, gas mains, sewer mains and services, cables, conduits, drainage and irrigation ditches and pipes, embankments and other structures in the vicinity of the work not authorized to be removed shall be supported and protected from injury by the Contractor during the construction and until completion of the work affecting them. The Contractor shall preserve intact any underground pipes or other utilities encountered during construction. The Contractor shall be liable for all damage done to such existing facilities and structures as herein provided and he shall save the City harmless from any liability or expense for injuries, damage, or repairs to such facilities. The type, size approximate location and number of all know underground utilities shall be shown on all drawings. It shall be the responsibility of the Contractor to verify the existence and location of all underground utilities along the route of the work.

In the event that during construction it is determined that any underground utility conduit, including sewers, water mains, gas mains and drainage structures or any above ground utility facilities are required to be relocated, the Contractor shall notify the owner of that utility well in advance of his approach to such utility so that arrangements with the utility owner can be made without delay to the work. All relocations will be done at the Contractor’s expense and upon approval by the Engineer.
4.05 OUTAGES

In the event loss of service is necessary; the Contractor shall coordinate with the Water Department and Inspector to determine the extent of outages. Customers shall be notified personally by the City Department of Public works at least 48 hours in advance and ensure that the loss of service shall in no case continue for more than 4 hours unless approved by the Public Works Department. Outages for schools, medical clinics and various commercial businesses must be conducted at approved times as specified by the Public Works Department. If outages for more than 4 hours are necessary, they must be conducted at times to cause the least amount of inconvenience to customers and only after approval by the City. Under all circumstances, work must be continuous until all customers are back in service. If, in the process of installing a connection, there exists an industry or building that cannot be without water as designated by the City, such as a hospital, appropriate temporary means shall be taken to provide and convey water. The City shall approve the water and means of conveyance.

4.06 SAFETY

Machinery, equipment, materials and all hazards shall be guarded or eliminated in accordance with the “Manual of Accident Prevention in Construction” of the Associated General Contractors of America and all applicable Federal regulations, including OSHA (Occupational Safety and Health Act), State, County and Municipal laws. No blasting shall be done without the approval of the Fire District Inspector and the City. Safety equipment, devices, and clothing shall be utilized by personnel where required by Federal, State and local laws.

4.07 BONDING

Developers and/or Contractors will be required to post bond to the City to provide protection against the following situations:

A. Repairs or work performed by the City caused by the Contractor.
B. Repair or work by the Contractor.
C. Necessary repairs caused by installing defective material.
D. Necessary repairs caused by poor installation techniques.
E. Costs incurred by the City due to the Contractor’s failure to perform in accordance with these standards.

Maintenance shall be guaranteed for a minimum of 1 year.
4.08 ACCEPTANCE OF WORK

Water and sewer utilities shall be inspected throughout installation. All utility testing must be completed and accepted in writing by the Inspector prior to any paving.

Prior to any building permits being issued, a punch list shall be formulated and sent to the Developer. Once this punch list has been completed and accepted, and as-built drawings for all utility lines and street improvements have been submitted to the City, the one-year guarantee period shall begin. The City shall send a letter to the Developer stating this. **No water meters shall be installed prior to initiating the 1 year guarantee period.**

Once the 1 year guarantee period begins the Developer shall be responsible for regular maintenance and repairs. The City shall be informed in writing of all maintenance and repairs that have been performed.

Just prior to the end of the 1 year guarantee period, a second inspection and punch list shall be formulated and sent to the Developer. Upon completion of this punch list by the Developer to the satisfaction of the City, the City shall then send a letter to the Developer stating the acceptance of responsibility for perpetual maintenance of the water and sewer utility lines by the City. Any deviations from this format shall be supported in writing by the City Engineer.

4.09 MATERIALS

SCOPE
The purpose of this section of the specifications is to set forth the general criteria to be used in the construction of water mains and appurtenances in the City service area. Any deviation from these standards must be supported in writing by the Engineer.

- All materials furnished shall be new and undamaged.
- Everything necessary to complete all installations shall be furnished and installed whether shown on approved drawings or not, and all installations shall be completed as fully operable.
- Acceptance of materials or the waiving of inspection thereof shall in no way relieve the Developer of the responsibility for furnishing materials meeting the requirements of the specifications.
- The Department of Public Works reserves the right to direct or deny use of certain types of materials in specific circumstances.
- All materials delivered to the job site shall be adequately housed and protected so as to ensure the preservation of their quality and fitness for the work.

1. Ductile Iron Pipe
• All ductile iron pipe shall be manufactured in accordance with AWWA Standard C-151, “Ductile Iron Pipe, Centrifugally cast in Metal Molds or Sandlined Molds for Water or Other Liquids”, with the following additional requirements or exceptions.

• “Push-on single gasket” type conforming with applicable requirements of AWWA Standard C-111, “Rubber Gasket Joints for Cast-Iron and Ductile Iron Pressure Pipe and Fittings”. Joint types other than “push-on single gasket” are acceptable if specifically approved by the Engineer.

• The grade of iron shall be 60-42-10 having a minimum tensile strength of 60,000 psi, minimum yield strength of 42,000 psi and a minimum percent of elongation of 10%.

• Pipe furnished under this specification shall conform to the pressure classifications recommended by the manufacturer.

• Pipe furnished shall be nominal laying lengths of either 18 ft. or 20 ft.. Random lengths are not acceptable.

• Pipe furnished shall have standard thickness cement mortar linings in accordance with AWWA Standard C-104, “Cement Mortar Lining for Cast-Iron and Ductile Iron Pipe and Standards for Water”, and the exterior coating shall be the standard outside bituminous coating as specified in AWWA C-151.

• The manufacturer shall furnish a certified statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable standards herein specified. A copy of the certification shall be sent to the Engineer upon request.

• Corrosion protection shall be covered in section 4.12 of these specifications.

• In general, ductile iron water pipe shall be installed per AWWA C-600.

2. Polyvinyl Chloride Pressure Pipe

• All polyvinyl pipe shall be manufactured in accordance with AWWA Standard C-900, “Polyvinyl Chloride (PVC) Pressure Pipe”. Plastic water pipe shall be blue in color. Minimum pipe requirements shall be DR-18 Class 150 and if required by the City DR-14 Class 200 pipe.

• Pipe joints shall be made using an integral bell with an elastometric gasket “push-on type” joint meeting the requirements of ASTM D-1869 and E-477. Solvent cement joints are strictly prohibited.

• Each length of pipe will be a standard laying length of 20 ft. Random length shall not be acceptable unless specifically approved by the Engineer. Under no circumstances shall the random length be less than 10 ft. long.

• PVC must conform with cast-iron outside diameters. Pipe stored outside and exposed to sunlight for more than 30 days shall be covered with an opaque material such as canvas. Clear plastic sheets shall not be used to cover the pipe. Air circulation shall be provided under the covering.
The manufacturer shall furnish a certified statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable standards herein specified. A copy of the certification shall be sent to the Engineer upon request. Tracer wire shall be required on PVC and other non-metallic water mains and other water line stub-outs. The type wire shall be coated 12-gauge solid copper wire. The wire will be installed on top of the pipe and run full length of the main. It shall be secured to the water line at least every 5 to 6 ft. Tracer wire shall come to grade in a 4 in. cathodic protection box placed directly behind each fire hydrant. Tracer wire shall extend a minimum of 1 ft. above grade. All connections shall be tight, and then coated and wrapped. The City shall approve connection methods.

All fire hydrant feed lines shall be ductile iron pipe (Class 52) and fittings shall conform to the specifications of this section. All connections and materials shall be approved and accepted by the City.

All fittings shall be manufactured in accordance with the following standards: C-153/A21.53 and ANSI/AWWA C111/A21.11 Cement Lined and Seal Coat per ANSI/AWWA C104/A21.4, “Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water”, C-110, “Ductile Iron Fittings” and C-153, “Rubber Gasket Joints for Cast-Iron and Ductile Iron Pressure Pipe and Fittings”, with the following additional requirement or exceptions.

All fittings shall be furnished with a cement mortar lining of standard thickness as defined in referenced specifications and given a seal coat of bituminous material or fusion bonded epoxy coated.

All fittings shall be furnished with mechanical joint or flanged ends conforming to referenced specifications and, in addition, the tee-head MJ bolts and hexagon nuts shall be fabricated from Ductile Iron Cor-ten or approved equal.

All fittings shall be of the 350 psi pressure rating and shall conform to the dimensions and weights shown in the tables of referenced specifications. All fittings shall be made from ductile iron.

Restraining for all fittings shall be in accordance with the Standard Details using concrete kick blocks and joint restraints.

The manufacturer shall furnish a certified statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the Engineer upon request.

Corrosion protection shall be covered in section 4.12 of these specifications.

3. Steel Pipe (AWWA C200, MODIFIED)

A. General

The Contractor shall provide mortar-lined steel pipe coated as specified herein, complete, in accordance with the Contract Documents. Materials, welding procedures, linings, coatings and certifications shall meet or exceed the requirements of the most current ANSI, ASTM, AWWA, and API standards.
B. Submittals

Fabrication Information:

a. Pipe/fitting wall construction details which indicate the type and thickness of cylinder; the position, type, size, and area of reinforcement; manufacturing tolerances; maximum angular joint deflection limitations; and all other pertinent information required for the manufacture and installation of the product.

b. Welded joint details shall be submitted for all joint types, including beveled ends for alignment conformance and deep bell or butt strap joints required for control of temperature stresses.

c. Rubber gasket joint design and details complete with dimensions, tolerances, and performance or test data.

d. Pipe Fabricator’s Credentials: Submit the credentials of the pipe manufacturer/fabricator. Credentials shall include reference names, telephone numbers, and descriptions of projects for pipe conforming to AWWA C200 that is of similar diameter, length, and wall thickness to the pipe in this project. Project description shall include length, diameter, wall thickness, steel metallurgy, location of facility where pipe was manufactured/fabricated, and names of key plant personnel responsible for the manufacturing process. Submit names and qualifications of current plant personnel to be responsible for manufacture of the pipe in this project.

Materials

a. Material lists and steel reinforcement schedules which include and describe all materials to be utilized. Metallurgical test reports for steel proposed for use on the project. Submit chemical and physical test reports from each heat of steel that indicate the steel conforms to the Project Specifications.

Line Layout Information

a. Line layout and marking diagrams compatible with the requirements of AWWA Manual 11 (M-11) and which indicate the specific number of each pipe and fitting and the location of each pipe and the direction of each fitting in the completed line. In addition, the line layouts shall include: the pipe station and centerline elevation at all changes in grade or horizontal alignment; the station and centerline elevation to which the bell end of each pipe will be laid; all
elements of curves and bends, both in horizontal and vertical alignment. The location of all metered pipe sections, beveled ends for alignment conformance, and deep bell or butt strap joints for temperature stress control shall be clearly indicated on the diagrams.

b. Drawings showing the location and details of bulkheads for hydrostatic testing of the pipeline, and details for removal of test bulkheads and repair of the lining.

c. Details and locations of closures for length adjustment, temporary access manways, vents, and weld lead pass holes as indicated and as required for construction convenience.

Welding Information

a. Information regarding location, type, size, and extent of all welds with reference called out for Welding Procedure Specifications (WPS) numbers shall be shown on the shop drawings. The shop drawings shall distinguish between shop and field welds. Shop drawings shall indicate by welding symbols or sketches the details of the welded joints, and the preparation of parent metal required to make them.

b. Written welding procedures for shop and field welds, including Welding Procedure Specifications (WPS) and Procedure Qualification Records (PQR).

c. Written nondestructive testing procedure specifications, and nondestructive testing personnel qualifications for shop and field welds.

d. Current welder performance qualifications (WPQ’s) shall be submitted for each welder used prior to its performing any Work either in the shop or field.

e. Submit the credentials of the Contractor’s certified welding inspectors (CWI’s) and quality control specialist for review prior to starting any welding in the shop or field. The credentials shall include, but not be limited to, American Welding Society QC-1 Certification.

f. Submit a welder log for field and shop welding. Log shall list all welders to be used for the Work and the types of welds each welder is qualified to perform.

g. Submit a written rod control procedure for shop and field operations demonstrating how the Contractor intends to maintain rods in good condition throughout the Work. The rod control procedure shall also demonstrate how the Contractor intends to ensure that the proper rods are used for each weld.

Field Lining

a. Submit field lining Contractor’s credentials.
b. Submit a description of lining equipment and personnel to be used.

c. Submit written procedures for pipe surface preparation, lining application, and curing.

d. Submit cement mortar mix design.

Certifications

Furnish a certified affidavit of compliance for all pipe and other products, materials, or related work provided under this Section, as specified in ANSI/AWWA C200, C205, C602, and C206, respectively, and the following supplemental requirements:

a. Compliance with the additional requirements included in these Contract Documents.

b. Hydrostatic test reports.

c. All materials are NSF approved for use with potable water.

d. All welds were performed in conformance with these documents.

e. All expenses incurred in making samples or collecting data for certification of tests shall be borne by the Contractor at no increased cost to the City.

C. Quality Assurance

a. Inspection: All pipe, linings, welds, coatings, and related work shall be subject to inspection at the place of manufacture and/or the place the Work is performed in accordance with the provisions of ANSI/AWWA C200, C205, C206, C602, C209, C214, and C215, as applicable, as supplemented by the requirements herein.

b. Tests: Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of ANSI/AWWA C200, C205, C206, and C602, as applicable.

1. After the joint configuration is completed and prior to lining with cement-mortar, if applicable, each length of pipe of each diameter and pressure class shall be shop-tested and certified to a pressure of at least 80% of the yield strength of the pipe steel. Test pressure shall be maintained for a minimum of 5 minutes. Any leaks shall be repaired and the pipe retested.
2. Perform said material tests at no additional cost to the City. The City shall have the right to witness all testing conducted by the Contractor; provided, that the Contractor’s schedule is not delayed for the convenience of the City.

3. In addition to those tests specifically required, the City may request additional samples of any material including mixed concrete and lining and coating samples for testing by the City. The additional samples shall be furnished at no additional cost to the City.

c. Welding Procedure Specifications: All welding procedures used to fabricate and install pipe shall be in accordance with the ASME Boiler and Pressure Vessel Code (BPVC) for shop welds and ANSI/AWS D1.1 for field welds. Written welding procedures shall be required for all welds, both shop and field. Welds qualified per the ASME BPVC shall include Supplementary Essential Variables for notch-tough welding. All provisions of ANSI/AWS D1.1 pertaining to notch-tough welding shall apply.

d. Welder Performance Qualifications: All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified by the Contractor under the provisions of ASME BPVC for shop welds and ANSI/AWS D1.1 for field welds. Furnish all material and bear the expense of qualifying welders.

1. Butt Joint Welds: Spot radiographically examine pipe in accordance with Paragraph UW-52 of the ASME Boiler and Pressure Vessel Code Section VIII, Division 1. If, in the opinion of the City, the welds cannot readily be radiographed, they shall be 100% ultrasonically examined.

2. Fillet Welds: 100% examine all fillet welds using the magnetic particle inspection method.

3. Groove Welds: 100% ultrasonically examine all groove welds that cannot be readily radiographically spot examined.

4. All Welds: Contractor’s certified welding inspector shall 100% visually examine all welds as a minimum.

e. Onsite Observation: The pipe fabricator shall provide an experienced staff member to be onsite while the pipe and fittings are being installed. The staff member’s duties shall include, but not be limited to, the following:

1. Observe the installation and welding of the pipe and fittings.

2. Report any concerns to the City’s onsite observer.
f. Certified Welding Inspector: Furnish the services of a certified welding inspector(s) for all shop and field welding as specified in AWWA C200 and C206. The certified welding inspector(s) shall 100% visually inspect all welds, verify proper procedures are being followed using qualified welders, supervise Contractor’s non-destructive testing, and witness City’s non-destructive testing. The welding inspector(s) shall submit written certification that all welds were performed in conformance with these documents. All shop weld tests shall be reviewed and signed by the inspector(s).

g. Pipe Manufacturer/Fabricator: The manufacturer or fabricator of the pipe shall be experienced in fabricating pipe of similar diameters and wall thicknesses required for this Work and shall have the manufacturing capability to meet the schedule requirements of this project.

D. Products

a. General

1. Steel pipe, linings and coatings shall conform to ANSI/AWWA C200, C205, C602, C209, C214 and C215, as applicable, subject to the following supplemental requirements. The pipe shall be of the diameter and wall thickness shown, shall be furnished complete with welded joints, as indicated in the Contract Documents. For pipe larger than 24 in. in diameter, the inside diameter after lining shall not be less than the nominal diameter indicated unless otherwise shown. Pipe 24 in. in diameter and smaller may be provided in standard outside diameters.

2. Pay the cost of replacement or repair of pipe which is damaged at no increased cost to the City.

3. Laying Lengths: Maximum pipe laying lengths shall not be limited unless specifically required by the Drawings. Contractor shall select lengths to accommodate the Contractor’s operation.

4. Lining: The pipe lining shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness.

5. Cathodic Protection System: Cathodic protection systems shall be applied to pipelines as required.

6. Shop-Welded Surfaces: All weld seams on pipe surfaces that will have a flexible tape coating. Do not grind into, or gouge, the adjacent pipe wall material.

E. Materials:
a. Cement: Cement for mortar shall conform to the requirements of ANSI/AWWA C205; provided, that cement for mortar coating shall be Type V, and mortar lining shall be Type II or V, per ASTM C150. Fly ash or pozzolan shall not be used as a cement replacement.

b. Pipe shall be manufactured as fabricated pipe per AWWA C200 as modified herein. ASTM pipe manufacturing standards referenced in AWWA C200 shall not be used. Pipe sections shall be fabricated by either of the following methods:

1. Pipe sections may be spirally welded or fabricated from short cylindrical courses joined circumferentially by complete penetration butt joint welds with not more than 2 longitudinal seams per course. Longitudinal seams shall be staggered on both sides of the pipe.

2. Pipe sections may be rolled or pressed from no more than 3 sheets the full length of the pipe and welded with no more than 3 longitudinal seams. Patching inserts, overlays, or pounding out of dents will not be permitted. Repair of notches or laminations on second ends will not be permitted. Damaged ends shall be removed as a cylinder and the section end properly prepared. Distorted or flattened lengths shall be rejected. A buckled section shall be replaced as a cylinder.

F. Specials and Fittings

a. Unless otherwise required, all specials and fittings shall be in accordance with Section 02572 - Steel Pipe Fabricated Specials and shall conform to the dimensions of ANSI/AWWA C208.

G. Design of Pipe

a. General: The pipe shall be steel pipe, mortar-lined and flexible, with field welded joints as indicated. The pipe shall consist of a steel cylinder, lined with portland cement-mortar as indicated, with an exterior coating of polyethylene tape.

b. Pipe Dimensions: The pipe shall be of the diameter and wall thickness shown on the Drawings. The minimum steel cylinder thickness for each pipe size shall be as indicated.

c. Joint Design: Unless otherwise shown, the standard field joint for steel pipe shall be butt-welded or a double-welded (fully circumferential) lap joint. Mechanically coupled, or flanged joints shall be required where indicated on the Drawings. Butt-strap joints shall be used only where required for closures or
where indicated. The joints furnished shall have the same or higher pressure rating as the abutting pipe.

d. Lap joints prepared for field welding shall be in accordance with ANSI/AWWA C200. The method used to form, shape and size bell ends shall be such that the physical properties of the steel are not substantially altered. Unless otherwise approved by the City, bell ends shall be formed by an expanding press or by the pipe being moved axially over a die in such a manner as to stretch the steel plate beyond its elastic limit to form a truly round bell of suitable diameter and shape. The ends shall not be rolled. Faying surfaces of the bell and spigot shall be essentially parallel, but in no case shall the bell slope vary more than 2 from the longitudinal axis of the pipe.

e. Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe as indicated or as otherwise acceptable to the City. Holdback areas shall be coated as hereinafter specified.

f. Joint Shop Coating: All holdback areas for welded joints, all butt straps, and all bell and spigot joint rings for rubber-gasketed joints shall be thoroughly cleaned and given a shop coat of rust-inhibitive primer.

H. Cement-Mortar Lining of Steel Pipe

Cement-Mortar Lining for Shop Application: Where indicated on the Drawings, interior surfaces of all steel pipe, fittings, and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C205. During the lining operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The lining machines shall be of a type that has been used successfully for similar work and shall be approved by the City. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at the delivery site, or after installation, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications at no additional cost to the City.

The minimum lining thickness shall be as follows, with a tolerance of plus $\frac{1}{8}$-in. or (-) $\frac{1}{16}$ in.

<table>
<thead>
<tr>
<th>Nominal Pipe Diameter (in.)</th>
<th>Lining Thickness (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 - 10</td>
<td>$\frac{1}{4}$</td>
</tr>
<tr>
<td>11 - 2</td>
<td>$\frac{5}{16}$</td>
</tr>
<tr>
<td>24 - 36</td>
<td>$\frac{3}{8}$</td>
</tr>
<tr>
<td>over 36</td>
<td>$\frac{1}{2}$</td>
</tr>
</tbody>
</table>
The pipe shall be left bare where field joints occur as indicated. Ends of the linings shall be left square and uniform. Feathered or uneven edges will not be permitted.

Defective linings, as determined by the City, shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective linings shall be cut back to a square shoulder in order to avoid feather edged joints. Temperature and shrinkage cracks in the mortar less than \( \frac{1}{16} \) in. wide need not be repaired. Pipe, specials, or fittings with cracks wider than \( \frac{1}{16} \) in. shall be rejected.

Protection of Pipe Lining/Interior: For all pipe and fittings with plant-applied cement-mortar linings, provide a polyethylene or other suitable bulkhead on the ends of the pipe and on all special openings to prevent drying out of the lining. All bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

I. Exterior Coating of Steel Pipe

Exterior Coating of Buried Piping: All buried piping shall be coated with a flexible coating.

Flexible coatings shall be Polyethylene Tape Coatings per AWWA standards.

Joint Diapers: Joint diapers for buried pipe with rigid mortar protective coat shall be as specified in this section, as applicable. Grout bands or heavy-duty diapers for protection of joints on cement-mortar coated pipe shall be polyethylene foam-lined fabric with steel strapping of sufficient strength to hold the fresh mortar, resist rodding of the mortar and allow excess water to escape. The foam plastic shall be 100% closed cell, chemically inert, insoluble in water and resistant to acids, alkalies and solvents, and shall be Dow Chemical Company, Ethafoam 222, or equal. The fabric backing of joint diapers shall be cut and sewn into strips wide enough to overlap shop-coated areas by 4 in. on either side. Strips shall have slots for the steel strapping on the outer edges. The polyethylene foam shall be cut into strips wide enough to match the uncoated field joint area and slit to a thickness of \( \frac{1}{4} \) in. which will expose a hollow or open cell surface on one side. The foam liner shall be attached to the fabric backing with the open or hollow cells facing towards the pipe. The foam strip shall cover the full interior circumference of the grout band with sufficient length to permit an 8 in. overlap of the foam at or near the top of the pipe joint. Splices to provide continuity of the material will be permitted. The polyethylene foam material shall be protected from direct sunlight.

4. Gate Valves
• Gate valves located at tees in the water main shall be located a minimum of 50 ft. apart.

• All valves shall be manufactured in accordance with AWWA Standard C-500, “Gate Valves for Water and Other Liquids” with the following additional requirements or exceptions.

• Valves shall be resilient wedge, ductile iron body, fully bronze mounted with non-rising stem and parallel seats. Solid wedge valves are not acceptable. Acceptable valves include the Mueller 2360-23, American Flow Control, U.S. Pipe Metroseal 250 MJ only resilient wedge valves or approved equal. All valves shall be suitable for frequent operations, as well as service involving long periods of inactivity. The design working pressure shall be 350 psi for all valves.

• Valve stems shall be threaded so that valves shall open by turning COUNTERCLOCKWISE. Each valve shall be furnished with a 2 in. sq. operating nut. The operating nut shall have an arrow showing the direction of opening and the word “OPEN” cast on the nut. The stem seal shall consist of 2 O-rings; 1 positioned above the thrust collar with the valve under pressure in the full open position.

• Bolts and hex nuts used on the bonnet of the valve shall be the manufacturer’s standard fabricated from a low alloy steel for corrosion resistance.

• Gaskets shall be full face with holes to pass bolts or cut to fit inside of bolts. Gaskets shall be used on all flanged joints intended to be watertight.

• Flanges shall be sized and drilled in accordance with ANSI B-16.1 Class 125 specifications. Flanges shall be machined to a flat face or machined to a flat surface with a serrated finish in accordance with AWWA Standard C-207 “Steel Pipe Flanges”.

• After approved factory assembly, each valve shall be given the operation and hydrostatic tests in accordance with the referenced specifications.

• The manufacturer shall furnish a certified statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the Engineer upon request.

• Corrosion protection shall be covered in Section 4.12 of these specifications.

• Valves shall be restrained in accordance with this section.

5. Valve Boxes

• Valve box parts shall be a 2 piece 6850 series manufactured by Tyler, Castings, Inc., or an approved equal and made of gray cast-iron. A 5-1/4 inch screw type shaft shall be adjustable from 39 to 60 in. Valve box lids shall be marked with the word “WATER” and shall have a lip or flange extending into the valve box shaft. No slip type boxes will be allowed. The valve box shall be of design which will not transmit shock or stress to the valve and shall be centered and plum over the operating nut of the valve with the box cover ¼ in. below the surface of the pavement. This must be inspected prior to paving.
• The manufacturer shall furnish a certified statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirement of the applicable standard(s) herein specified. A copy of the certification shall be sent to the Engineer upon request.
• Valve boxes should meet minimum weights and dimension as shown in the Standard Details.

6. Butterfly Valves

• All valves larger than 16 in. shall be butterfly valves, Class 150B and shall conform to Sections AWWA C-504. All butterfly valves shall be furnished with flanged end connections and shall be suitable for buried service installation. Butterfly valves used for buried service shall be similar to the “Groundhog” manufactured by the Henry Pratt Company or an approved equal. Shafts shall be a one-piece unit constructed of stainless steel and shall extend completely through the valve disc body. Shaft bearing material shall have a proven record of service of not less than 5 years. Shaft seals may be designed for the use of standard split-V packing or for standard “O” ring seals. Valves shall be fitted with a 2 in. operating nut and shall open to the left (counterclockwise). All butterfly valves shall be installed in manholes. All valves shall have extended shaft to top of valve boxes with indication (Pratt Diviner) for direction of open, number of turns, and make and model of valve. (See Standard Detail).
• The manufacturer shall furnish a certified statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the Engineer upon request.
• Corrosion protection shall be covered in section 4.12 of these specifications.

7. Pressure Reducing and Regulating Valves

• All pressure reducing valves shall be Clayton 90-01 series or an approval equal. The pressure reducing valve shall be hydraulically operated with a free floating guided piston having a seat diameter equal to the size of the valve. The valve shall be fully bronze mounted and all packing shall have rubber seals to provide tight closure and prevent metal to metal friction. An indicator rod shall be furnished as an integral part of the valve to show the position of the piston within the valve body. The valve shall be designed to provide an access opening in the valve body for removing the piston and other internal parts without removing the main valve body from the line.
• Material shall be cast-iron for valve body; flanges and covers shall conform to ASTM Standard Designation A-48. Bronze castings or parts for internal trim shall conform to ASTM Standard Designation B-61.
• All valves shall be furnished with flanged ends and drilled in accordance with ANSI B-16.1 Class 125 specifications. Flanges shall be machined to a flat face or
machined to a flat surface with a serrated finish in accordance with AWWA Standard C-207.

- The pilot valve for controlling operations of the main valve shall be a single seated, diaphragm operated and spring loaded type. The pilot valve shall be attached to the main valve with piping isolation valves so arranged for easy access in making adjustments and also for its removal from the main valve while the main valve is under pressure. Pilot control system shall be cast under pressure. Pilot control system shall be cast bronze ASTM B-62 with 303 stainless steel trim.

- The needle valve shall be all bronze and included with the main valve to control the speed of piston travel.

- The operating pressure shall be 150 psi minimum.

- The body of the pressure reducing valve shall be given a hydrostatic test of 50% more than the operating pressure specified herein. A second test to check seating of the cylinder shall be made at the operating pressure.

- All pressure reducing and regulating valves shall be installed in concrete vaults as specified in the standard details.

- The manufacturer shall furnish a certified statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the Engineer upon request.

8. Air Valves

Air Valves shall be of 2 types as follows:

1.) An Air Valve called for on the plans shall mean an Air and Vacuum Valve of the ball type designed to permit the escape of air from a pipeline when the line is being filled and to permit air to enter the pipeline when the line is being emptied.

2.) A Combination Air Valve called for on the plans shall mean a combination Air and Vacuum and Air Release Valve designed to fulfill the functions of an Air and Vacuum Valve and also designed to permit the escape of air accumulated in the line at the high point when the line is under pressure while in operation. The valve shall be self-contained in 1 unit, not a combination of 2 valves. This type would normally be used.

Air valves shall be installed at each high point in all water mains of 12 in. diameter and larger or as specified by the City Engineer. Two–inch air valves shall be installed as shown in the standard details. Maximum spacing between air valves shall be 1,320 ft. Installation shall include 2 in. gate valves between saddle and air valve for maintenance purposes. They shall be installed in precast concrete manholes or vaults as specified in the standard details and fitted with air vents of adequate cross section.
open to the atmosphere as designed by the Engineer. A minimum of 1 ft. of 1 and 1-
1/2 in. rock shall be placed under the pipe in air valve manholes. When air valves are
required, specifications shall be submitted to the Engineer for review and approval.
(See Standard Details).

9. Blowoff Assemblies

All water mains installed having dead-ends where stagnant water may collect shall be
provided with blow off devices which will allow flushing of the main without
interruption of water service. Refer to blow off assembly detail in these
specifications for water mains 12 in. or less in diameter. All water mains larger than
12 in. in diameter shall have blow off assemblies of at least 6 in. diameter. A
temporary blow off assembly may be used on 12 in. diameter or smaller water mains
where water main construction has temporarily terminated between phases in a
development (see Standard Details). Design for installation of blowoffs 6 in. and
larger shall be approved by the Engineer.

10. Vaults

All valve vaults shall be designed to adequately house the valves and fittings therein
contained, as well as to withstand all external loadings imposed by earth, thrust, and
AASHTO H-20 highway live loading. Vaults shall be furnished with removable roof
slabs to allow removal of all valves and fittings. They shall also be sized so as to
allow sufficient room for valve maintenance and minor repair and shall be furnished
with manhole rings for easy access. They shall be construction in such a manner as to
allow operations of all valves from above ground and shall be fitted with air vents
open to the atmosphere. Vaults shall be made waterproof after construction by use of
sealants, epoxies, or other approved methods. If the vault is not be in a street, the
roof shall be designed to support the overhead earth fill and any other reasonable
loading that may occur and shall have aluminum steps fitted and secured in concrete.
Concrete floors shall have 12 in. diameter by 18 in. deep sump holes in corner with
access to outside of vault. The design of any vault shall be approved by the Engineer
prior to any installation.

11. Precast Concrete Manholes

Refer to Standard Drawings of these specifications.

12. Concrete

- All cement used shall be Portland cement acceptable under ASTM Designation C-
150 “Standard Specifications and Tests for Portland Cement”. Cement used shall
be Type II. The design mix of Portland cement, fine aggregate, course aggregate,
water and admixtures shall be submitted along with test results of the design mix
to the Engineer for approval upon request. The mix design shall conform to
CHAPTER FOUR STANDARDS AND SPECIFICATIONS
WATER SUPPLY FACILITIES

C.D.O.T. Class B, 3500 psi concrete. Hand mixed concrete will not be permitted unless it is “sackrete 5000 in. 5000 psi concrete or approved equal.

- Concrete shall not be placed on frozen subgrade. Concrete shall be placed only in the presence of the inspector unless inspection has been waived prior to the placement. When concrete is deposited against ground without the use of forms, the ground shall be thoroughly moistened or other provisions made to prevent the ground from drawing water from the concrete. Newly placed concrete shall be allowed to set undisturbed for a minimum curing time of 24 hours. When concrete is placed at temperatures below 40° F. and rising, the Contractor shall provide satisfactory methods, as determined by the Engineer, and means to protect the mix from injury by freezing and comply with all America Concrete Institute (ACI) standards or latest revisions. After placement of concrete, an 8 mil. polyethylene covering shall be required for 24 hours in order to allow for proper curing. No trucks shall be permitted to place concrete, if placement does not begin prior to 90 minutes from when the truck left the plant. Allowable slump shall be 3 in., + or – 1 in..

13. Concrete Reinforcement

All deformed reinforcing bars shall conform to ASTM Standard A-615, Grade 40 or 60, or ASTM Standard A-617, Grade 40 or 60. All welded steel wire fabric shall conform to ASTM Standard A-185.

14. Galvanized Materials

Under no circumstances shall any galvanized fittings or material be used unless specifically approved by the Engineer.

15. Fire Hydrants

- All fire hydrants shall conform to and be tested in accordance with AWWA Specification C-502. Fire hydrants shall be made of cast iron with full bronze mountings. Inlet shall fit 6 in. pipe with barrel length sufficient for a 5 ft. trench. Hydrants shall have one 4-1/2 in. pumper connection and two 2-1/2 in. hose connections, and the main valve opening in the fire hydrant shall be not less than 5 in. in diameter. Threads on all nozzles shall be National Standard. All fire hydrant shall OPEN CLOCKWISE (right hand). Only compression type main valve that close with the water pressure will be accepted. Valves will open counterclockwise (left hand).

- A traffic breakaway feature shall be incorporated into the barrel of the hydrant at the ground line. The operating nut shall be National Standard pentagon measuring 1-1/2 in. from point to opposite flat. Nozzle covers shall have the same size and shape nut as the operating nut. The hydrant shoe will have a mechanical joint fitting with the tee-head bolt and hexagon nut made of Cor-Ten.
• Each hydrant shall have drain holes with a minimum 18 in. of 1-1/2 in. rock beneath them. (Refer to Drawings). A sheet of 8 mil. polyethylene should be placed over the rock to prevent dirt from filling the rock. Hydrant color shall match existing City hydrant color (Safety Yellow). All hydrants shall stand plumb and shall be connected to the street main by a 6 in. branch line. The branch line shall be ductile iron (Class 52) pipe only. An independent 6 in. gate valve shall be installed on each fire hydrant branch, using a mechanical joint swivel tee. Thrust blocks under and behind the fire hydrant base shall be placed per fire hydrant detail in these specifications. Megalugs shall be used on all hydrant branch lines in place of rodding. RODDING WILL NOT BE ALLOWED. Fire hydrant base shall be adjusted to not more than 3 in., nor less 2 in. from the bottom of the hydrant flange to the top of finished grade, when finish grade has been established. All hydrant extensions needed to place hydrant at correct grade shall be considered essential to the project and not a separate pay item. Maximum height of extensions of hydrant is 12 in. No hydrant base shall be installed any deeper than 6 ft. from the top of finished grade.

• No part of the fire hydrant assembly shall protrude over the edge of sidewalks. Minimum distance from driveways shall be 5 ft. Depending upon hydrants location, the use of steel posts filled with concrete might be required for protection, as specified by the inspector. Fire hydrants shall be placed on property lines at corners or in the middle of the block in residential areas. Fire Hydrants shall not be placed in cul-de-sacs. All hydrants shall be located within the right-of-way on public streets or in an unfenced utility easement coordinated with the Fire District. No obstruction in front of hydrant, 5 ft. to the sides and 3 ft. to the back. New fire hydrants shall be re-painted.

• Corrosion protection shall be covered in section 4.12 of these specifications.

Fire hydrants shall be limited to the following manufacturers only:
- Mueller Company 5-1/4 Centurion
- MH Style 129.
- Waterous WB 250

For additional information refer to fire hydrant detail of these specifications.

4.10 MISCELLANEOUS

Where special conditions not covered by these specifications exist, detailed drawings and specifications shall be submitted to the City for approval before contracts are awarded or work is begun. Written approval from an authorized representative of the City Department of Public Works must be obtained before any materials other than those materials specified in the standard specifications may be employed in the construction of water and sewer lines connected to or made a part of the water and sewer system of the City.
4.11 **RESTRAINED JOINTS/THRUST PROTECTION**

Restrained joints/thrust protection shall be provided in locations where thrust forces may cause pipe joints to separate. Harness lugs and rods are not an acceptable method of joint restraint unless accepted by the City in special circumstances. Acceptable methods of thrust restraint include the following:

- a. Megalugs or bell and spigot restrained joints
- b. Welded joints for steel pipe
- c. Concrete thrust blocks

For pipe larger than 12 in. in diameter, thrust protection calculations and methodology shall be completed by a Professional Engineer and submitted to the City for review.

Thrust blocks shall be constructed at all bends and fittings which result in unbalanced line thrust. Care shall be taken not to block outlets or to cover bolts, nuts, clamps, or other fittings or to make them inaccessible. A bond breaker shall be placed between the fitting and the thrust block to aid in case of future removal. The vertical sides of the concrete thrust blocks shall be formed to allow for symmetrical thrust. All concrete thrust blocks shall be designed for shape and size as required by internal pressure and load bearing capacity of the soil and shall in every instance bear against undisturbed earth. If soil bearing strength is unknown, soil bearing capacities used in design must be approved by the Engineer. When it is impossible through over excavation or other causes to pour a thrust block against undisturbed earth, megalugs shall be required to anchor the fittings to the main upon approval of the Engineer. Backfill may be placed over the thrust block once the surface has set sufficiently to resist the weight of the backfill. However, no tamping or compacting shall be allowed above the thrust block for a minimum of 24 hours after placement. Refer to thrust block details in these specifications.

4.12 **CORROSION PROTECTION**

Ductile Iron Pipe

- All Ductile Iron Pipe, fittings and valves shall be protected as specified in this section.
- All ductile iron pipe, fittings and valves shall be hand wrapped using polyethylene with a minimum wall thickness of 2 layers of 8 mil. and a 2 in. wide, 10 mil thick, polyethylene pressure sensitive tape to close seams or hold overlaps.
- All polyethylene encasement material shall be manufactured in accordance with AWWA Standard C-105. The raw material used to manufacture polyethylene film shall be Type I, Class A, Grade E-1 in accordance with ASTM Standard Designation D-1248.
- In all cases, the polyethylene shall be so applied as to prevent the contact of backfill material with the fitting.
Soil resistivity tests may be required at the sole discretion of the City. Other means of corrosion protection must be specifically approved by the City. The developer/Contractor shall incur the costs of all soil testing if required.

Steel Pipe

Soil resistivity tests shall be taken then analyzed by a corrosion specialist to determine the need for and extent of corrosion protection. In most cases it is assumed that the 3 layer tape wrap system will protect the pipe in normal soils. However, the City desires to have each case analyzed. Refer to the City of Aurora Standards, Section 16 for Corrosion control requirements for steel pipe.

4.13 EXCAVATION

All excavations shall be made to the lines and grades as established by the approved drawings in open cut, through whatever material encountered. Pipe trenches shall be excavated to the bottom of the pipe. All areas shall be excavated in such a manner as will afford adequate drainage. Where material encountered within the limits of the work is considered unsuitable by the inspector, such material shall be excavated below the grade shown on the drawings to a depth necessary to ensure a stable, firm foundation and refilled with approved native backfill material to provide a firm foundation. All excavated materials which are considered unsuitable and any surplus of excavated material shall be disposed of by the Contractor.

All existing asphalt or concrete surfacing shall be cut vertically in a straight line as specified in Chapter 2 and removed from the job site prior to starting the trench excavation. This material shall not be used in any fill or backfill.

The trench shall be excavated so that a minimum clearance of 12 in. is maintained on each side of the pipe for proper placement and compaction of the bedding or backfill material. The maximum trench width measured at the top of the pipe shall be the outside diameter of pipe plus 24 in. The trench shall be adequately supported and the safety of workers provided for as required by the most recent standards adopted by the Occupational Safety and Health Act.

Trench excavation shall not advance more than 300 ft. ahead of pipe laying and backfilling work.

Excavation for structures shall be of such dimensions as to allow for the proper installation and to permit the construction of the necessary pipe connections.

4.14 DEWATERING
All pipe trenches or structure excavation shall be kept free from all water during pipe laying and other related work. The method of dewatering shall provide for a completely dry foundation at the final lines and grades of the excavation. All water shall be disposed of in a suitable manner without being a menace to public health or causing a public inconvenience. The dewatering operation shall continue until such time as it is safe to allow the water table to rise in the excavations. Pipe trenches shall contain enough backfill to prevent pipe floatation.

4.15 PIPE BEDDING

After completion of the trench excavation and proper preparation of the foundation, bell holes shall be dug deep enough to provide a minimum of 2 in. of clearance between the bell and the bedding material. All pipe shall be installed in such a manner as to ensure full support of the pipe barrel over its entire length. After the pipe is adjusted for line and grade and the joint is made, the backfill material shall be carefully placed and tamped under the haunches of the pipe up to spring line and in the previously dug bell holes.

4.16 INSTALLATION OF PIPE

Pipe and fittings shall be loaded and unloaded by lifting so as to avoid shock or damage. Under no circumstances shall such material be dropped. Before the placing of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of all foreign material, kept clean at all times and examined for cracks or defects before installation.

Joint lubricant is required and shall be a product approved by the pipe manufacturer.

When laying pipe on curves, the pipe shall be kept in alignment by deflecting joints (see Section 4.01.14). Pipe shall be laid with the bell ends facing in the direction of laying unless directed otherwise by the inspector.

Whenever the pipe is left unattended, temporary plugs shall be installed at all openings. Temporary plugs shall be watertight, Standard Cast Iron and of such design as to prevent children and animals from entering the pipe. All temporary plugs shall be approved by the inspector.

No pipe or appurtenant structure shall be installed upon a foundation into which frost has penetrated or at any time when the inspector deems there is a danger of ice formation or frost penetration at the bottom of the excavation. No pipe or appurtenant structure shall be installed unless backfilling can be completed before the formation of ice and frost.

Immediately before joining 2 lengths of pipe, the inside of the bell and the outside of the spigot end of the gasket shall be thoroughly cleaned. Caution shall be exercised to ensure
the correct type of gasket is used. A thin film of gasket lubricant shall be applied to either the inside face of the gasket or the spigot end of the pipe or both.

The spigot end of the pipe shall be placed in the socket with care to prevent the joint from contacting the ground. The joint shall be completed by pushing the pipe home with a slow steady pressure, without jerky or jolting movements. **Stabbing shall not be permitted.** Pipe furnished without a depth mark shall be marked before assembly to ensure insertion to the full depth of the joint.

Extra care should be used in handling PVC pipe during cold weather due to the reduced flexibility and impact resistance as temperatures approach and drop below freezing.

### 4.17 INSTALLATION OF VALVES AND VALVE BOXES

All valves shall be handled in such a manner as to prevent any injury or damage. All valves shall be thoroughly cleaned before installation. Valves shall be set in such a manner that the valve stems are plumb. Valves shall be located at points as shown on the approved construction plans. **Whenever possible, valves shall be located near the property line extension where applicable, or near the intersection P.C.**

Valve boxes shall be installed plumb. Valve boxes which have shifted during backfill operations and are no longer plumb, shall be re-excavated and realigned to the satisfaction of the inspector.

### 4.18 CHLORINATION AND CLEARWATER TESTS

Under no circumstances shall a non-disinfected main which cannot be isolated be connected to an existing, disinfected main. The Contractor will assume any and all responsibility for damage done by heavily chlorinated water entering existing facilities due to negligence on his part. All water mains shall adhere to the following sequence of tests: (1) chlorine; (2) pressure tests; and (3) clearwater test (see Sections 4.35, 4.36 & 4.37).

### 4.19 TRENCH BACKFILL

It is expected that the trench excavation will provide suitable backfill material. Wet, soft or frozen material, pieces of asphalt or concrete or other undesirable substances shall not be used for backfill. The backfill material shall be free from rubbish, stones larger than 5 in. in diameter, and frozen lumps of soil. If the excavated material is not suitable for backfill as determined by the inspector, suitable material shall be hauled in and utilized and the rejected material hauled away and disposed of.
Backfilling shall be conducted at all times in a manner to prevent damage to the pipe or its coating and shall be kept as close to the pipe laying operation as possible.

All backfill around structures shall be consolidated by mechanical tamping.

Backfill in areas where existing pavement is to be cut and replaced, unsuitable material excavated shall be removed from the site and the trench backfilled with gravel road base to finished or existing grade as specified in this section. Excess material to be removed prior to surfacing.

- **Bedding Zone** shall consist of squeegee material placed below the pipe invert, 6 in. in depth minimum.

- **Pipe Zone** shall consist of squeegee material placed above the pipe invert to a minimum of 6 in. above the pipe.

- **Backfill Zone** shall consist of material above pipe zone.

- **Flowable Fill** may be substituted for Pipe Zone material when approved by the City.

The bedding zone and pipe zone shall be backfilled with clean squeegee well graded meeting the following gradation.

<table>
<thead>
<tr>
<th>Sieve No.</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>95-100</td>
</tr>
<tr>
<td>8</td>
<td>80-100</td>
</tr>
<tr>
<td>16</td>
<td>50-85</td>
</tr>
<tr>
<td>30</td>
<td>25-60</td>
</tr>
<tr>
<td>50</td>
<td>10-30</td>
</tr>
<tr>
<td>200</td>
<td>0-5</td>
</tr>
</tbody>
</table>

### 4.20 TRENCH BACKFILL COMPACTION

Compaction shall be obtained by placing material in horizontal layers brought up uniformly within the trench and compacted throughout the depth of the trench. If material other than squeegee is used for backfilling around pipes, lift thickness shall not exceed 6 in. In the “Backfill Zone” above the “Pipe Zone”, lift thickness shall not exceed 12 in.
Trench backfill in the right of way shall be compacted to at least 97% of the maximum density and within plus or minus 3% of optimum moisture content as determined by the Standard Proctor ASTM 698D. Trench backfill in “Field” excavations shall be compacted to at least 95% of the maximum density and within plus or minus 3% of optimum moisture content as determined by the Standard Proctor ASTM 698D.

If, in the judgment of the Inspector, the trench shows signs of being improperly backfilled or if settlement occurs, the trenches will be reopened to a depth required for proper compaction, refilled and recompressed, all in accordance with these specifications. If a special backfill material is encountered, the recommendation of a Geotechnical Engineer shall be required in order to attain the necessary trench compaction.

Compaction tests, taken by an independent commercial laboratory, shall be taken every 100 ft. or at the discretion of the inspector. The inspector shall pick the location and depths at which all compaction tests will be taken. The inspector shall be present when each test is taken and the results shall be forwarded to the Department of Public Works. The Contractor shall bear the costs of all compaction testing.

4.21 TRENCH MAINTENANCE

For a period of 1 year after completion of the installation (1 year warranty period), the Contractor shall maintain and repair any trench settlement which may occur and shall make suitable repairs to any pipe, fittings, valve, valve box, pavement, sidewalks, or other structures which may be damaged as a result of backfill settlement as determined by the Engineer.
4.22 HYDROSTATIC TESTING

- No hydrostatic tests shall be made on any portion of the pipeline until all field placed concrete has had adequate curing time.
- The pipeline shall be tested with water only at double normal operating pressure or a pressure of 150 psi, whichever is greater.
- The Department of Public Works shall be notified 24 hours in advance of testing. All acceptance testing shall be made in the presence of the inspector.
- The Contractor shall furnish the calibrated meter for testing. The pipeline shall be in a state of readiness for testing. (Gauge must read to within 5 psi)
- All air in the line shall be properly purged. Where blow-offs or hydrants are not available or effective in purging air from the line, the inspector shall require a tap to purge the line. The location and size of the tap shall be at the inspector’s discretion.
- No leakage is allowed through the bonnet of the line valve. Any valve leaking through the bonnet shall be removed and replaced.
- The pressure test shall be a 2 hour test taken at the high point in the line. Every time the water line pressure drops 5 psi, the pump will be started to bring the line pressure back to the initial pressure.
- Polyvinyl chloride or ductile iron pipe shall be considered to have passed the pressure test when the total leakage per hour is less than:

\[
L = \frac{SD (P)^{\frac{1}{2}}}{133,200}
\]

Where
- \(L\) = allowable leakage in gallons per hour
- \(S\) = length of pipe tested, in ft.
- \(D\) = nominal diameter of the pipe, in inches
- \(P\) = average test pressure during the leakage test, in pounds per square inch (gauge)

The Inspector shall direct the Contractor to repair specific leaks regardless of test results, if in his opinion they are serious enough to endanger the future service of the pipeline. Pipelines shall be tested in sections as rapidly as such section may be isolated. Should any leakage of the pipeline become apparent during the 1 year guarantee period, the Developer or their authorized representatives shall perform the necessary repairs. Blow-offs, pressurizing pump, corporation stops and water measuring apparatus shall be provided by the Contractor.

The City Utilities Department shall not be held responsible for water tightness of its valves on existing facilities. If existing valves leak, the City will assist in exercising valves, but the Contractor must use methods at his own disposal to work with the resulting leakage.
Contractor will be required to go around and check all water valves to ensure they are fully open after the water line has been completed, prior to it being released to the City.

All fire hydrant lines shall be pressure tested. It is recommended that the fire hydrant be dry. All fire hydrants shall be tested by flushing each hydrant a minimum of 5 minutes before they will be accepted.

4.23 REPAIR FITTINGS

The use of repair clamps, repair sleeves, joint clamps and similar devices is permitted to repair existing mains not under warranty. Repair clamps shall be of stainless steel construction in the band, lugs, nuts, and stainless steel bolts. These devices should not be considered substitutions for careful installation of mains. Repair clamp design and make shall be submitted to the Engineer for approval prior to installation.

4.24 SERVICE PIPE GENERAL INFORMATION

All water service line construction connecting to the City water system shall be done in accordance with these specifications. These specifications shall cover all new water service line construction from the water main to the building plumbing. Any deviations from these standards must be supported in writing by the Engineer.

4.25 SERVICE PIPE MATERIALS

All materials furnished shall be new and undamaged. Everything necessary to complete all installations shall be furnished and installed whether shown on the approved drawings or not and all installations shall be completed as fully operable. Acceptance of materials or the waiving of inspection thereof shall in no way relieve the developer of the responsibility for furnishing materials meeting the requirements of these specifications.

The Department of Public Works reserves the right to direct or deny use of certain types of materials in specific circumstances.

All materials delivered to the job site shall be adequately housed and protected so as to ensure the preservation of their quality and fitness for the work.

The minimum size allowable for a service line shall be ¾ in. diameter.

1. Copper Service Pipe
   Type “K” copper shall be used for service lines ¾ in. through 2 in. in diameter.

2. Ductile Iron Service Pipe
Ductile iron pipe used for service pipe shall conform to section 4.09 of these specifications. Ductile iron pipe shall be used for all service lines larger than 2 in.

3. Curb Stops/Ball Valves

Ball valves are used for 1 in. and smaller service lines and shall be installed 4 in. below the meter yoke as shown in the standard details. Ball valves shall be compression to compression connections and shall meet the following requirements:

<table>
<thead>
<tr>
<th>Size</th>
<th>Make</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>¾”</td>
<td>Ford</td>
<td>B44-333Q</td>
</tr>
<tr>
<td></td>
<td>Mueller</td>
<td>B-25209</td>
</tr>
<tr>
<td></td>
<td>A.Y. McDonald</td>
<td>6100Q</td>
</tr>
<tr>
<td>1”</td>
<td>Ford</td>
<td>B44-444Q</td>
</tr>
<tr>
<td></td>
<td>Mueller</td>
<td>B-25209</td>
</tr>
<tr>
<td></td>
<td>A.Y. McDonald</td>
<td>6100Q</td>
</tr>
<tr>
<td>1-1/2”</td>
<td>Ford</td>
<td>B44-666Q</td>
</tr>
<tr>
<td></td>
<td>Mueller</td>
<td>B-25209</td>
</tr>
<tr>
<td></td>
<td>A.Y. McDonald</td>
<td>6100Q</td>
</tr>
<tr>
<td>2”</td>
<td>Ford</td>
<td>B44-777Q</td>
</tr>
<tr>
<td></td>
<td>Mueller</td>
<td>B-25209</td>
</tr>
<tr>
<td></td>
<td>A.Y. McDonald</td>
<td>6100Q</td>
</tr>
</tbody>
</table>

Curb stops are used for service lines 1-1/2 in. and larger and are set in the service line on the inlet side, approximately 2 ft. upstream of the meter pit or vault, as shown in the Standard Details and provide a means to shut off the service line for repairs inside the meter vault. Curb stops shall be a stop and waste type valve and shall be a Mueller H10284, or Ford 67B11666SW or B11777SW.

Curb stop service boxes for 1-1/2 in. and larger service lines shall be cast iron Tyler 95E or Castings Inc. CI95E, or an approved equal. The curb stop box shall be installed exactly center over the curb stop valve and in a vertical position. The top lid of the curb stop box shall be installed level with the final grade.

4. Corporation Stops and Saddles

Corporation stops shall be AWWA taper thread to copper connection of pack joint and shall be a Ford Type F1000Q, Mueller H15008 or A.Y. McDonald 4701Q, or an approved equal. Taps up to 2 in. shall be made by the City Utilities Department personnel for existing water mains. New water main taps shall be performed by the Contractor.

Saddles for PVC C-900 pipe shall be Ford S90, S902 or S912 non-hinged, Mueller H-13000 series or A.Y. McDonald 3805, or an approved equal. Saddles
for ductile iron pipe shall be double strap bronze Ford 202B, Mueller B2B series or A.Y. McDonald 3825, or an approved equal.

4.26 SERVICE PIPE LOCATION

That portion of the service pipe between the main and the ball valve/corp stop must be continuous and straight with no joints and perpendicular, if possible, to the main. Service line stubbed into the property line shall be of sufficient length to allow direct connection to the ball valve/curb stop.

The main to be tapped must extend along the entire length of the front lot line of the property to be served.

If service is requested for a lot at the end of a cul-de-sac street, the main to be tapped must be not more than 25 ft. from the curb line or the proposed curb line at the end of the cul-de-sac. The service pipe between the main and the property line in cul-de-sacs shall be in a continuous straight line and shall enter the property a distance of 2 to 4 ft. from the nearest lot corner. No service line may be constructed through or in front of any adjoining property. When possible, the service line shall be located 5 ft. toward the low side of the lot from the centerline of the lot. Service lines are not to extend beneath driveways unless otherwise approved by the Engineer. Sewer and water service lines must be a minimum of 10 ft. apart horizontally or concrete encasement or special protection of the sewer line will be required. Service locations will also be marked with a “V” on the curb. Markings shall be stamped or chiseled, not painted.

4.27 SERVICE PIPE DEPTH

All service pipe must be laid 4-1/2 to 5 ft. below the established grade of the street in which they shall be laid and all other places at least 4-1/2 ft. below the surface of the ground. If, in the judgment of the Engineer, the topography indicated the advisability thereof, service pipe shall be laid to a lower depth as required by the Engineer on the basis of then existing information.

If, after a service pipe has been installed, the grade of the surface of the ground is lowered, the service pipe must be lowered to provide at least 4-1/2 ft. of cover.

4.28 SEPARATE TRENCHES

Except as hereinafter provided, service pipe may not be installed in a trench containing other conduits which conduct any substance other than potable water. The trench
containing the service pipe shall be separated laterally from trench containing other conduits by at least 10 ft. of undisturbed compacted earth.

### 4.29 SERVICE PIPE CONNECTIONS

- Service pipe 2 in. or less in diameter shall be connected to the main by means of a bronze corporation stop.
- Service pipe larger than 2 in. in diameter shall be connected to the main by tee connection (wet tap).
- No underground joints are allowed in the copper service pipe between the corporation stop and the ball valve/curb stop. Meters shall be of the same size as that portion of the service pipe between the meter and the main unless otherwise stated by the Engineer. All meters shall be placed a minimum of 10 ft. apart.
- ¾ and 1 in. meters shall be set by City Utilities Department personnel or their duly authorized representatives. Larger meter which require vaults and by-passes must be installed by the Contractor.
- No meter will be set until the service line and copper setter (on residential) or curb stops (on commercials) have been installed.
- Taps will not be made on a water main until the main has passed the pressure tests and clearwater tests. No flaring of service lines will be allowed.
- Care should be taken to properly install water service lines so that enough slack is in the service lines to protect against pullout problems.
- Water mains will be tapped at a 45° angle from the horizontal centerline of the water main on the same side of the pipe as the water meter.
- Tapping mains may require digging out bedding materials and cutting or removing part of the corrosion protective wrapping. After the taps are made, the wrap shall be repaired or replaced by the installing Contractor in such a manner as to protect both the pipe and the main. Taps shall be backfilled with squeege and hand tamped to fill any voids.
- Service taps on the main shall have minimum separation of 24 in. and be no closer than 24 in. to a coupling.
- Service lines from the meter to the building must be the same size as the line from the main to the meter, unless approved otherwise by the City.
4.30 PUMPS

Except when specifically authorized by the Engineer, the installation of pumps on service pipes designed to increase water pressure inside the premises receiving service is prohibited.

4.31 LAWN SPRINKLERS

Lawn sprinkler systems must be tapped on the outlet side of the meter pit or a direct tap on the main line with a meter setting. All devices utilized for cross connection control must meet the minimum requirements of AWWA, the Uniform Plumbing Code, as well as the approval of the Building Department. All devices for cross connection control shall be inspected by the City Building Department.

4.32 RETAP AND RELOCATION CHARGES

Only one domestic tap is allowed per single family residence. If the water main has been tapped once, and for any reason another service tap is required, a retap charge will be assessed prior to the retap unless waived by the Engineer for a good cause shown. If it is necessary to abandon an existing water tap, it shall be turned off and disconnected at the tap at the main. Such charge shall also be assessed if it is necessary to relocate the water meter pit out of a driveway area with a Ford or Mueller compression fitting.

Contractors and/or developers guilty of flagrant violations of these standard specifications, as determined by the City Engineer, shall be subject to revocation of bonds and loss of Contractor’s license.

4.33 FIRE LINE WITH DOMESTIC SERVICE CONNECTIONS

No domestic water service may be tapped from a fire line or fire hydrant lateral. All fire lines and water services must be tapped separately from the existing main.

4.34 NEW AND REPAIRED MAINS

This procedure is to be followed prior to the City accepting:
1. a newly installed water main or
2. a repaired pre-existing water main.
It covers disinfection, bacteriological sampling and reporting of results.
Installation will be in accordance with established AWWA standards (AWWA C-600) with particular attention paid to the provision for cleanliness within the pipe itself. Flushing and disinfection will be performed by the Contractor in accordance with AWWA Standard C-651 (more detailed instruction will be found below). Sampling (bacteriological and chlorine residual) will be performed by personnel from a certified testing lab. Chlorine residual analysis will be performed using precision chlorine test papers (BASF Wyandotte Corp.); bacteriological testing will be performed by qualified technicians from a certified testing lab. The release form will be required from the testing lab with copies to Public Works Department, and the Contractor prior to the City accepting new mains for service.

After a main has been repaired and flushed, personnel from the City Utilities Department shall inspect the water for color, turbidity, and chlorine residual prior to restoring the repaired main into service.

4.35 DISINFECTION

Disinfection will be accomplished using tablet form Hypochlorite. These will be affixed to the inside top with an approved adhesive (i.e., Permatex #1 or equivalent). Dosage will be calculated for a 200 mg/1 (ppm) chlorine concentration for volume of installed pipe (this is to allow for the refilling of pre-existing pipe attached to the installed sections). The chlorine solution will remain in contact with the piping for a minimum of 24 hours, and a maximum of 48 hours. Chlorine content will be checked by the City.

4.36 FLUSHING

After chlorination or disinfection of the pipeline, flushing will commence to remove the chlorine solution. Flushing will continue for a minimum of 5 minutes beyond the time when chlorine is no longer detectable.

4.37 BACTERIOLOGICAL SAMPLING

After flushing, personnel from a certified laboratory will sample for bacteriological contamination. If the samples show no bacteriological growth and are free from excessive turbidity, the City Utilities Department will release the main for service and will initiate the required forms. If samples show bacterial growth, the entire system shall be disinfected and flushed according to the procedures described in this Chapter. Per the Tri County Health Department, samples should be taken every 1000 ft. of pipe, or each fire hydrant, which ever is more frequent. A minimum of 2 samples will be analyzed.
4.38 GENERAL INFORMATION

1. Inside Installation

Water meter installations inside any buildings are specifically prohibited.

2. Jumper Pipes

Jumper pipes are permitted during the construction phase for the purpose of checking the service line and interior plumbing for leaks. The jumper pipe is to be removed from the water meter yoke prior to the request for inspection.

3. Warranty

A 1 year warranty as to materials and workmanship will be in affect upon final acceptance of the meter pit or vault.

4. Water Meters

All water meters, regardless of size, connected to the City’s utility system shall be furnished by and remain the property of the City Water Department. Under no circumstances shall anyone other than City Water personnel remove a water meter once the pit or vault has been inspected and approved, unless otherwise specified by the Engineer.

5. Special Meter Installations

In any installation where special or unusual conditions might exist, detailed drawings, accompanied by a letter of explanation shall be submitted to the City Utilities Department.

6. Water Meters Over 4” in Size

For any water meter installation over 4 in. in size, detailed drawings of the proposed installation shall be submitted to the Engineer for approval.

7. Easements

The City shall be provided easements for water meter installation if Right-of-Way is not already provided.

8. Electrical Wiring
There shall be no electrical wiring allowed in any water meter pit or vault unless otherwise authorized by the Engineer, except remote meter head wiring as per City specifications.

9. Inspection of Residential Pits and Commercial Vaults

Inspection of all residential pit and commercial pit or vaults shall be conducted by personnel from the City Utilities Department. Locations for commercial pits or vaults shall be determined by personnel from the City Water Department.

10. Meter Sizes

All meter sizes for residential, commercial, or industrial use shall be determined by the consulting engineer and submitted to the City for review and approval. If water pressures in a building are determined to be inadequate for that facility, the City shall not be held responsible.

4.39 WATER METER SPECIAL INFORMATION

1. 24” Pit Installation

   Copper Setters

   Copper setters of the proper laying length to accommodate the water meter are required on all installation of ¾ and 1 in. water meters. A list of the laying length is provided:
   - ¾ x ¾ in. water meter = 9 in.
   - 1 x 1 in. water meter = 11 in.

   Cutting of the copper setter for the purpose of increasing or decreasing the span of the copper setter is specifically prohibited.

2. Meter Sizes for Duplexes

   The minimum allowable meter size for a duplex is 1 in..

4.40 WATER METER INSTALLATIONS

1. Meter Pits for ¾” and 1” Services

   Meter pits shall be constructed of Polyethelene or PVC material, 48 in. high, and 20 in. inside diameter and ½ in. wall thickness. The trench floor under the masonry base shall be compacted earth. Copper service pipe entering and leaving the pit shall be of sufficient length so as to meet the depth specifications as
outlined in the Standard Details when the copper setter is installed. The meter pit shall not bear on the service pipe. No flared connections will be allowed.

2. Meter Manholes for 1-1/2” and 2” Services

Meters shall be installed in 48 in. diameter, precast concrete manholes with flat top lids. Ring and covers shall be 24 in. with “WATER” lettering. Curb stops shall be located 2 ft. upstream of the manhole (see Standard Details). Precast concrete vaults shall be used for 3 in. and larger services.

3. Copper Setter Installation

The copper setter shall be of an all copper and brass construction and shall have an angled ball valve on the inlet side of the copper setter and a double check valve on the outlet side. The copper setter, when installed, shall be 4 in. below the top of the meter pit for 1 in. and smaller services (see the Standard Details). A variance of more than 1 in. will not be accepted. A bypass shall be required for 1-1/2 and larger services.

Following is a list of acceptable copper setters:

<table>
<thead>
<tr>
<th>Size</th>
<th>Make</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4”</td>
<td>Ford</td>
<td>VBHH83W-44-33Q</td>
</tr>
<tr>
<td></td>
<td>Mueller</td>
<td>B-2474-2A</td>
</tr>
<tr>
<td></td>
<td>A.Y. McDonald</td>
<td>31D309WDQQ33</td>
</tr>
<tr>
<td>1”</td>
<td>Ford</td>
<td>VBHH84W-44-44Q</td>
</tr>
<tr>
<td></td>
<td>Mueller</td>
<td>B-2474-2A</td>
</tr>
<tr>
<td></td>
<td>A.Y. McDonald</td>
<td>31-4—WDQQ44</td>
</tr>
<tr>
<td>1-1/2”</td>
<td>Ford</td>
<td>VBH76-12B-11-66</td>
</tr>
<tr>
<td></td>
<td>Mueller</td>
<td>B-2423-2</td>
</tr>
<tr>
<td></td>
<td>A.Y. McDonald</td>
<td>20B612WDF665</td>
</tr>
<tr>
<td>2”</td>
<td>Ford</td>
<td>VBH77-12B-11-77</td>
</tr>
<tr>
<td></td>
<td>Mueller</td>
<td>B-2423-2</td>
</tr>
<tr>
<td></td>
<td>A.Y. McDonald</td>
<td>20B712WDF775</td>
</tr>
</tbody>
</table>

4. Water Meter Pit Covers (Typical Installation)

The dome and top lid shall be of cast iron construction. The top lid shall have a touch read pad hole. Frost lids shall be a Castings Inc., or approved equal, type plastic, deep-dish inner lid. When installed, the dome shall be 1-2 in. above the final grade in landscape areas and shall be flush with grade for installation in concrete areas. The center of the dome’s top lid when installed shall be between 2 and 3 ft. behind sidewalk or curb and gutter. Meter pits shall be located a
minimum of 10 ft. apart. On new installations, meter pits shall not be installed in driveways.

5. Water Meter Pit Covers in Traffic Areas

Meter pit covers shall be cast iron heavy duty rated for traffic loads and shall be Castings, Inc., CIW3, Ford W3, or approved equal.