

SECTION 02550

WATER PIPING SYSTEMS

PART 1 GENERAL

A Description of Work:

This work consists of furnishing and installing water mains, service lines, and appurtenances. This includes all equipment, tools, materials, labor, and other incidentals to provide water mains and service lines complete and ready for immediate and continuous use. The work includes, but is not limited to, all necessary excavation, backfilling, compaction, testing, clean up, and restoration required for a complete installation of water mains, service lines, and appurtenances.

B. Related Work:

Section 02300	-	Trench Excavation and Backfill
Section 02310	-	Flowable Fill
Section 02560	-	Sewer Line Construction
Section 02650	-	Traffic Control
Section 03300	-	Concrete Structures

C. Definitions:

1. Distribution main means a water main that supplies one or more branch mains.
2. Fire Service Line means pipe and appurtenances delivering water from the City water distribution system to a building fire extinguishing system. Fire service lines may be located on private property or in public ROW and are owned, operated, and maintained by the property being served.
3. Fire hydrant assembly means the materials located from the city main to the fire hydrant including the tee or tap, piping, auxiliary valve hydrant and all other equipment constructed for the purpose of providing the fire hydrant.

4. "L" length for Joint restraining devices means the length of pipe from a fitting, valve, or feature that needs to have each pipe joint within that length restrained.
5. Private Fire Protection System means hydrants, valves, water pipes, and appurtenances, sprinkler systems, hose connections, and other equipment constructed for the purpose of providing fire protection for a building or group of buildings and supplied with water from a public water supply system. Private Fire Protection Systems are located on private property, although some components may be located in public ROW, and are owned, operated, and maintained by the property being served.
6. Transmission Main means a water main that supplies many tributary branches, serves a large area, and has few taps.
7. Water mains are those pipes of at least four (4) inches in diameter, which will be installed in public right-of-way or easements and will become a part of the City water distribution system and which will be owned, operated, and maintained by Lake Havasu City.
8. Water service line shall mean the line from the main to the meter box which is normally entirely located within the right-of-way and is owned and maintained by the City. The water meter is then connected to the property water distributing system and which the property owner is responsible for repair and maintenance.

D. Submittals:

Submittals shall be required unless otherwise specified in the Plan Notes or Special Provisions. The term "Submittals" includes, but is not necessarily limited to, manufacturer's product data sheets of pipe, appurtenances, and fittings. Submittals shall be submitted for, but not limited to, the following items:

Fire hydrants, pipe, pipe fittings and their appurtenances including T-bolts, joint restraints, polyethylene encasement, and any other pertinent information concerning construction materials that the Engineer deems necessary for the review of the materials used on the project in accordance with the specifications and drawings.

Resubmittals shall be made in the same manner as submittals, with changes clearly shown.

PART 2 MATERIALS

2.0 Pipe:

General: Pipe for water mains shall be Polyvinyl Chloride (PVC) or ductile iron with push on joints as specified on the plans or in the Special Provisions.

1. PVC pressure pipe, 4 inches through 12 inches, shall conform to the requirements of AWWA Specification C-900, Pressure Class 305 DR-14 and meet the below standard.
 - a. PVC pipe shall have bell ends with elastometric gaskets. Pipe joints shall use the Rieber joining system, which has the gasket formed into the pipe during the pipe manufacturing process. Installation procedures shall conform to AWWA C-605 Standards.
2. PVC pressure pipe, 14 inches through 36 inches, shall conform to the requirements of AWWA Specification C-905, Pressure Class 305 DR-14. PVC pipe shall have bell ends with elastometric gaskets. Pipe joints shall use the Rieber joining system, which has the gasket formed into the pipe during the pipe manufacturing process. Installation procedures shall conform to AWWA C-605 Standards.
3. Ductile iron pipe shall conform to the requirements of AWWA Specifications C-150 and C-151, Pressure Class 350 unless specified otherwise on the plans or Detailed Specifications. Ductile iron pipe shall be coated on the outside with a bituminous coating 1-mil thick, minimum, and shall be cement-mortar lined in accordance with AWWA Specification C-104. Linings shall be full thickness to the end of the spigot and to the seat of the bell, or shall be tapered for a length of not more than two inches.

Rubber gasket joints for all Ductile Iron pipe shall meet the requirements of AWWA C-111. Installation procedures shall conform to AWWA C-600 Standards.

4. Water service pipe 1 inch service pipe shall be Type "K" soft copper tubing; pipe larger than 1 inch up to 2 inches shall be polyethylene pipe and shall conform to AWWA C901 and PC200. 4 inches and larger service pipe shall be PVC or ductile iron pressure pipe as specified for water pipes, above.

Type K soft copper tubing shall be US Government Type K Soft Tubing in 100 – foot single or double pancake coils for 1 inch diameter material. The minimum center coil diameter shall not be less than 16 inches.

1 ½ and 2 inch service pipe shall be Polyethylene Plastic Tubing meeting AWWA C901 "Polyethylene Pressure Pipe & Tubing" Pressure Class 200 psi.

Water service pipe larger than 2 inches shall meet the specifications above for PVC pressure pipe or ductile iron pipe.

2.1 Fittings:

1. Water main fittings:

General: Fittings used with ductile iron pipe shall be ductile iron. Fittings 12 inches and smaller, used with PVC pipe shall be ductile iron or PVC. Fittings used for PVC diameters larger than 12 inch shall be ductile iron.

All bolts and nuts shall conform to AWWA C111 and ASTM – A325 Type 3. The bolts and nuts shall be Cor-Blue, fusion bonded epoxy, Series 300 stainless steel or approved equal. Coated bolts and nuts shall be "near white" or "white" metal with 8 to 10 mil minimum coating thickness.

Fitting types applicable to this specification consist of bends, crosses, tees, reducers/increasers, plugs, caps, couplings, and sleeves.

- a. Ductile Iron water main fittings: Fittings shall be ductile-iron with 350-psi pressure rating and rubber gasket joints meeting all applicable requirements of the latest edition of AWWA C110, C111, and/or C153 Specifications. All internal and external ferrous surfaces shall be coated with a minimum 6 mil thick fusion bonded epoxy coating applied electrostatically and at a minimum shall meet the requirements of AWWA C116.

Unless specified otherwise on the plans or Detailed Specifications the following fitting joint shall be provided:

- Fittings 8 inches and smaller shall be push-on joint.
- Fittings 10 inch and 12 inch shall be push-on joint or mechanical joint. If the fitting is going to be restrained then it shall be a mechanical joint.
- Fittings 14 inches and larger shall be mechanical joint.

Push-on joint fittings shall be furnished with restraining lugs. The lug pattern for all sizes shall accommodate gripper-type restrainers.

- b. PVC water main fittings: PVC fittings may be used in-lieu of ductile iron fittings for PVC pipe installations 12 inches and smaller. PVC fittings shall meet all applicable requirements of the latest edition of AWWA C900 Pressure Class 305 and AWWA C907. The PVC fitting bell ends shall have elastometric gaskets. Installation procedures shall conform to AWWA C-605 Standards.
- c. Couplings: Straight and transition couplings shall be as manufactured by Ford, Romac Industries, Inc., or equal and shall have ductile iron center rings and end rings meeting ASTM A536-80, Grade 65-45-12. Center rings shall be epoxy coated. Gaskets shall be SBR compounded for water service. Couplings for 12 inch and larger pipe shall be a minimum 12 inches in length.
- d. Tapping Sleeves shall be ductile iron or stainless steel, flanged branch ends, with test plugs for pressure testing. The Sleeve shall be approved for use at pressures equaling or exceeding those of the pipe classification being installed. Ductile iron tapping sleeves shall be mechanical joint with totally confined end gaskets. Stainless steel tapping sleeves shall have a 304 stainless steel shell with SBR gaskets compounded for water service, a stainless steel flange, and shall have 304 stainless steel nuts, bolts, and washers.

2.2 Valves:

General: Valves smaller than 12 inch shall be gate valves and valves 12 inches and larger shall be butterfly type or gate valves as specified on the plans or detailed specifications.

All internal and external ferrous surfaces shall be coated prior to assembly with a minimum of 6 mils of fusion bonded epoxy coating applied electrostatically prior to assembly meeting the requirements of AWWA C550.

Additionally an exterior coating of Polyurea/Polyurethan Hybrid Resin per American AVK Company, or equal maybe added to the epoxy coatings required above.

Bolts and nuts shall be Cor-Blue, fusion bonded epoxy, Series 300 stainless steel or approved equal

1. Gate Valves shall conform to the requirements of AWWA Standard C509 and C515 with a 250-psi pressure rating and shall have a ductile iron-body

and bonnet, be resilient seated, utilize mechanical joints including gaskets and bolts, and include all accessories. Gate valves shall have ductile iron wedge fully encapsulated with a SBR rubber or Nitrile elastomer coating. Stems shall be non-rising; one piece cast, forged or rolled bronze. Valves shall have two (2) inches ductile iron operating nuts and shall open left, counter clockwise. Bonnet bolts and nuts shall be Series 300 stainless steel and shall be rust proofed after threading and final tightening.

2. Butterfly Valves shall conform to the requirements of AWWA C504, Class 150B for buried installation. Butterfly valve box body and disk shall be ductile iron ASTM A-536. Shaft shall be stainless steel. Seat shall be Buna-N, field replaceable without special tools and shall provide tight shutoff as required by AWWA C504. Mating surfaces shall be stainless steel. Bearings shall be self-lubricating, corrosion-resistant, and shall be designed for horizontal and/or vertical shaft loading. Shaft seals shall be designed for the use of bi-directional, self-adjusting packing, replaceable without removing the valve shaft.

Actuator shall be designed for buried service and shall be grease-packed, totally sealed. Actuator shall be equipped with a mechanical stop-limiting device to prevent over-travel of the valve disc in the open and closed positions. Actuator shall be equipped with 2 inches operating nut, which is hex-mated to the input stem and shall open by turning counter-clockwise.

2.3 Valve Boxes:

1. Gate Valves and Butterfly Valves:

Valve Boxes shall be Tyler Union 6850/60 series 2-piece screw-type construction, or East Jordan (EJIW) Series 8550 3-piece screw type or equal and shall have a five and one-fourth (5 1/4) inches riser. Drop lids shall be marked "Water" and are to be of all-metal construction.

2. Valve Box Adaptor:

A valve box adaptor shall be installed on the valve bonnet prior to installing the valve box. The valve box adaptor eliminates shifting of the valve box, protects the coatings, centers the valve box, and seals the valve box with a resilient material. The adaptor shall be incidental to the valve box installation. The valve box adaptor shall be installed per the manufacturer's recommendations. The valve box adaptor shall be a "Valve Box Adaptor II" as manufactured by Adaptor Inc., a "Valve Box Self-

Centering Alignment Ring" as manufactured by American Flow Control, or an approved equal.

2.4 Fire Hydrants:

Fire hydrants shall meet AWWA Standard C-502 and shall be Mueller Centurian, Clow Medallion, East Jordan 5CD250, American AVK Series 2700, or Waterous Pacer.

traffic model with 6 ft. bury and 6 inches mechanical joint inlets. Hydrants shall have 5 ¼ inches minimum valve openings, having O-ring packings and oil chamber to hold soft oil for stem thread lubrication, and shall have all operating parts, including valve seat, removable through the barrel. Barrel and upper standpipe shall be ductile iron with breaker flange and operating stem at ground level. A steel breakaway coupling shall be installed on the operating stem so that in case of breakage, no damage will result to the fire hydrant other than safety breakers.

All internal and external ferrous surfaces shall be coated with a minimum of 6 mils of epoxy coating and at a minimum shall meet the requirements of AWWA C550 and AWWA C116 as applicable.

All external ferrous surfaces below the fire hydrant "bury line" including the fire hydrant riser (barrel) sections and adjoining 90 degree ells shall be coated with HB Fuller IF1947T Red Oxide Powder, Tnemec Series 140 Pota-Pox Epoxy or equal meeting the requirements of AWWA C550 and AWWA C116 as applicable.

Additionally an exterior coating of Polyurea/Polyurethan Hybrid Resin per American AVK Company, or equal may be added to the epoxy coatings required above.

All exposed nuts and bolts below the breakaway (direct bury) shall be series 300 stainless steel.

All hydrants shall be capable of being extended in six (6) inches increments. However, the minimum hydrant adjustment shall be 12 inches.

Hydrants shall be constructed so that they will close with the existing water pressure acting on the hydrant. Drain valves shall be bronze and shall be positively operated by the main operating rod. All threads shall be National Standard threads. Operating nuts shall be 1 ½ inches point-to-flat, pentagon (National Standard). Hydrants shall open left, counter clockwise. Fire Hydrants shall have an internal travel stop nut.

Hydrants are to have two (2), two and one-half (2 1/2) inches nozzles and one (1) four and one-half- (4 1/2) inches steamer nozzle, all with National Standard threads. The minimum distance from the hydrant breaker flange to the centerline of the lower nozzle shall be sixteen (16) inches. Caps shall be nut type and shall be provided with chains. Hydrants shall be painted Caterpillar yellow.

All Fire Hydrants are to be ordered with barrel lengths of five (5) to eight (8) feet to facilitate their installation per the grades and lines shown on the drawings. Adjustments greater than eight (8) feet shall be accomplished using vertical bends (45, 22½, or 11¼) along the hydrant lead. The use of a Fire Hydrant Extension will not be an acceptable method of adjustment for a new Fire Hydrant, provided the necessary information was communicated on the drawings or specifications. If this information was communicated and the hydrant requires adjustment for final grade, then the Contractor shall replace the Fire Hydrant with a new Fire Hydrant with the correct barrel length or install the appropriate vertical bends on the hydrant lead.

In cases where a Fire Hydrant Extension will be installed, the Contractor shall furnish the appropriate extension.

2.5 Service Lines, Valves and Fittings:

General: All fittings used shall meet current safe drinking water guidelines for lead free fittings, solder and flux. All service line, valves and fittings shall meet AWWA Standard C-800 (ASTM B62 and B-584, UNS No C83600-85-5-5) and NSF/ ANSI 61 Annex F. Shall have a 300 psi working pressure.

1. 1 inch services

1 inch services shall be assembled as shown on the detail named " 1 Inch Service Connection and Termination Details". All fittings shown shall meet the specified manufacturers minimum material specifications or equal.

- a) Service connection: the connection to the main shall consist of using a service saddle, corporation stop and un-spliced copper tubing in order to provide water to the meter box. The service saddle shall be a Ford 202B Double Band Brass Saddle or equal. The 1" corporation stop shall be a Ford FB-1000-4 or equal. Copper tubing in described in the previous section "Water Service Pipe".
- b) Service Termination: the service termination consists of connections made to the copper tubing that is stubbed out at the property line at the proposed meter box location. At

the end of the tubing a 1 inch ball valve shall be placed, a short piece of 1 inch tubing (10-12 inches in length) to a service tee (if dual meters are necessary), then a ball meter valve shall be placed at each end of the tee branch. If a single service is to be installed a 1 inch angle meter stop shall be installed after the short piece of tubing.

The one inch angle meter stop shall be a Ford BA43-444W or equal, the one inch service tee shall be a Ford T884-334-9 or equal, the ball meter valve shall be a B13-332W or equal and the 1 inch ball valve shall be a Ford B44-444 or equal.

2. 1 ½ and 2 inch services

1 ½ inch services shall be assembled as shown on the detail named "Service Connection and Termination Details". All fittings shown shall meet the specified manufacturers minimum material specifications or equal.

- a) Service connection: the connection to the main shall consist of using a brass saddle and corporation stop in order to provide water to the meter box. The brass saddle shall be a Ford 202B Double Band Brass Saddle or equal. The 1 corporation stop shall be a (Ford FB-1100-6 for 1 ½ inch)(Ford FB 1000-7 for 2 inch) or equal. Polyethylene Tubing shall be used and is described in the previous section "Water Service Pipe".
- b) Service Termination: the service termination consists of connections made to the polyethylene tubing that is stubbed out at the property line at the proposed meter box location. At the end of the tubing a Pack Joint Coupling (Ford C84-66 for 1 1/2 inch) (Ford C84-77 for 2 inch) or equal shall be attached, a 1 ½ or 2 inch brass 90 degree street elbow shall then be attached, then a Ball Valve (Ford # B11-666W for 1 ½ inch) (Ford # B11-777W for 2 inch) or equal shall be attached.

3. Meter boxes

For 1 inch service lines plastic meter boxes shall be Carson/ Brooks or equal. In Traffic areas meter boxes shall be Christy Fiberlite or equal.

For 1 1/2 inch service lines the meter box shall be a Christy Fiberlite box # FL-30T Box 12 w/ lid # FL-30D.

For 2 inch service lines (with no by pass) the meter box shall be a Christy Fiberlite box # FL 36T Box 18 w/ lid # FL36D01. For 2 inch service with a bypass the box shall be a NDS Pro Series Box # 126B with a Pro Series Lid with Reader Cover part # 126BCDMCIFB

4. Tapping sleeves and valves shall be used for service lines larger than 2 inches.

2.6 Concrete Thrust Blocks:

Thrust blocks shall be 4000 psi concrete as specified in Section 03300 of these specifications.

2.7 Joint Restraining Devices

1. Joint Restraint Devices at Fittings shall meet the following requirements:

In general, solid ring restraints shall be used whenever possible. Split restraints may be used when connecting to existing systems, for special cases, and when a solid ring restraint is not available for the application. All joint restraint devices shall be epoxy coated (min. 6 mils), utilize the "E Coat" coating system as specified by the Ford Meter Box Co., Inc., or utilize the "Mega-Bond" coating system as specified by EBBA Iron, Inc. All bolts, rods, etc. shall be COR-Blue, epoxy coated, stainless steel, or fluoropolymer coated per EBBA Iron, Inc. and the Ford Meter Box Co., Inc. specifications.

- a. For DI pipe to DI push-on fittings:

Fitting Joint Restraints shall be EBAA Series 1100HD, or equal.

- b. For DI pipe to DI MJ fittings:

Fitting Joint Restraints shall be EBAA MEGALUG Series 1100, Series 1100SD, or equal.

- c. For PVC pipe to DI push-on fittings:

Fitting Joint Restraints shall be EBAA Series 15PF00, or equal.

- d. For PVC pipe to DI MJ fittings:

Fitting Joint Restraints shall be EBAA Series 2000PV, Series 2000SV, Series 15PF00, or equal.

- e. For PVC pipe to PVC push-on fittings:

Fitting Joint Restraints shall be EBAA Series 2500, or equal.

- 2. Joint Restraint Devices at pipe bells shall meet the following requirements:

In general, solid ring restraints shall be used whenever possible. Split restraints may be used when connecting to existing systems, for special cases, and when a solid ring restraint is not available for the application. All joint restraint devices shall be epoxy coated (min. 6 mils), utilize the "E Coat" coating system as specified by the Ford Meter Box Co., Inc., or utilize the "Mega-Bond" coating system as specified by EBBA Iron, Inc. All bolts, rods, etc. shall be COR-Blue, epoxy coated, stainless steel, or fluoropolymer coated per EBBA Iron, Inc. and the Ford Meter Box Co., Inc. specifications.

- a. For ductile iron pipe:

The bell restraint shall be EBAA Series 1700, or equal.

In lieu of bell restraint devices, push on joints with the American Fastite Joint system with Fast Grip Gasket, or equal may be used when approved by the Engineer.

- b. For PVC C-900 pipe:

The bell restraint shall be EBAA Series 1600, or equal.

- c. For PVC C-905 pipe:

The bell restraint shall be EBAA Series 2800, or equal.

2.8 Polyethylene Encasement:

Polyethylene Encasement (poly-wrap) shall meet AWWA C-105.

For ductile iron pipe, the encasement shall be 8-mil thickness, seamless tube, black ASTM D-1248, Type 1, Class C, Grade G-1. Joint tape for encasement shall be 3M Scotchwrap 50, or equal.

2.9 Combination Air Release Valves:

Air Release Valves shall be constructed in accordance with the detailed drawings.

Air release valves shall be designed to meet the working pressure for the location in the system where the valve will be placed in to service.,

Air release valves shall be the size and style indicated on the drawings and similar to APCO 143C and 145C, Crispin or equal.

2.10 Tracer Wire System:

Tracer Wire shall be a direct bury wire that meets or exceeds the following requirements:

- a. Conductor: 12 AWG solid strand soft drawn copper per ASTM B-3, or B-8. The breaking pounds of the wire shall be a minimum of 124 with an O.D. of 0.154. All wire shall be spark tested at 7500 VAC.
- b. Insulation: Conductor shall be insulated with low density high molecular weight polyethylene insulation suitable for direct bury applications per ASTM D-1248. The minimum insulation thickness shall be 0.045. The color of the insulation shall be blue with a print line saying "WATER".
- c. Splices and or Connectors: Splices and or Connectors should be capable of handling from 2 to 4 wires per connector and designated as "water-proof". PVC adhesives or sealing compounds are not acceptable.
- d. Tracer Wire Access Box: Tracer wires shall be terminated using a small terminal box suitable for flush burial with a 2½ inches lockable cast iron top, integral stainless terminals and a minimum 12 in. ABS bottom section.
- e. Tracer Wire System Manufactures:

- Tracing Wire – Kris Tech Wire Co. Inc., Paige Electric Corporation, or equal.
- Splice Kit/Connectors -3M epoxy type compounds, fusible heat shrink tubing, 3M DBY connectors, or Snaploc LV 9000 direct bury wire connectors, or equals.
- Tracer Wire Access Box – Valvco Pipe Tracer Wire Terminal Box or equal.

PART 3 CONSTRUCTION REQUIREMENTS

3.1 Materials Handling and Storage:

The Contractor shall be responsible for the safe handling and storage of all materials furnished by them and shall replace, at their expense, all such materials found defective in manufacture or damaged in transportation, handling, or storage.

Pipe, fittings, and accessories shall be loaded and unloaded by lifting with hoists or skidding to avoid shock or damage. Under no circumstances shall such materials be dropped. All material shall be stored in a neat and orderly manner. Pipe shall be stored, to the greatest extent possible, in unit packages or bundles and shall be handled to prevent stress to bell joints and prevent damage to bevel ends. In addition, materials shall be handled and stored in accordance with manufactures' recommendations.

If in the opinion of the Engineer damage or defects to the factory applied external coatings on steel or ductile iron pipe and fittings (including fire hydrants) can not be repaired, then the Contractor shall replace the damaged items with new materials.

If in the opinion of the Engineer damage or defects to the factory applied external coatings on steel or ductile iron pipe and fittings (including fire hydrants) can be repaired, then the Contractor shall make said repairs as follows:

If approved by the Engineer, the Contractor may make repairs when damage or defects occur in the factory applied external epoxy or "MEGABOND" coatings supplied on steel or ductile iron pipe and fittings (including fire hydrant risers and joint restraint devices). Coating repairs shall be made using a high build, low temperature applicable, fast cure, liquid epoxy

coating. This epoxy coating material shall be Protal 7125 Repair Cartridge in packaged two component tubes with dispensing gun as manufactured by DENSO North America Inc.

When high ambient temperatures (i.e., > 85 degrees F) occur or when metal surface skin temperatures are high (i.e., > 100 degrees F) such that use of the DENSO Protal 7125 Repair Cartridge may be difficult due to the very short handling time of the material, an alternate modified amine cured epoxy coating may be used. This alternate coating shall be TC 7010 FS-Gray fast setting epoxy coating as manufactured by Tapecoat Co.

3.2 Alignment and Grade:

Pipe shall be laid true to the line and grade established on the Drawings. Where the Drawings indicate that the finished ground surface elevations are to be modified from the existing elevations by this or future construction, the Contractor shall exercise care to ensure that pipe, fittings, hydrants, valves and valve boxes are placed to the elevations indicated on the plans.

3.3 Underground Obstructions:

The Contractor shall expose existing underground obstructions shown on the plans or located in the field and shall determine their elevations far enough in advance of pipe laying that the proposed water main can be installed without the use of fittings at or near the points of crossing. Wherever obstructions not shown on the plans are encountered during the progress of the work and interfere with the proposed horizontal or vertical alignment of the pipeline, the Engineer will change the plans and order a deviation in the line and/or grade, or may arrange for the removal or relocation of the obstructions. The Contractor shall not deviate from plan line or grade without the Engineer's approval.

3.4 Water Main and Sewer Main/Storm Sewer Separation:

1. Vertical Separation at Crossings:

Water mains may cross above sanitary and storm sewers with a minimum vertical distance of twentyfour (24) inches between the invert of the water main and the top of the sewer. In these cases where the water main is above the sewer and there is at least 24 in. of separation, then at the crossing no extra protection is required.

At all other crossings the sewer shall be constructed of ductile iron pipe with mechanical joints, or approved equal, for a distance of at least 10

feet in each direction measured perpendicular to the water line. As an alternate, the sewer shall be encased in concrete a minimum of 6 inches thick for the same distance.

2. Water Main and Sewer Main/Storm Sewer Horizontal Separation:

Water mains shall be constructed with a minimum of 6 feet of horizontal separation from any existing sanitary or storm sewer or proposed sanitary or storm sewer. The 6 feet horizontal separation shall be the clear distance (water pipe sidewall to sewer pipe sidewall) and not the centerline distance between the utilities.

3. Unusual Conditions:

Where conditions prevent a minimum horizontal and vertical separation as set forth above, both water and sewer should be constructed of mechanical joint joint cast iron pipe, or approved equal, and pressure tested to assure water tightness before backfilling. Where a water main must cross under a sewer, a vertical separation of at least 18 inches between the bottom of the sewer and the top of the water main shall be maintained, under all conditions, with adequate support provided for the sewer lines to prevent them from settling on and breaking the water main.

4 Sewer Manholes:

No water pipe shall pass through, or come in contact with any part of the sewer manhole.

3.5 Installation:

1. Trenching shall comply with the requirements of Section 02300 Trench Excavation and Backfill.
2. Minimum Cover depth from top of pipe to finished grade shall be as follows:

Size of Pipe (In.)	Minimum Cover (Ft.)
12 or less	5
14 or larger	6

3. Cleaning shall be done as necessary so that the interior of all water pipe and fittings is free from all dirt, cement, or other foreign material before installation. Contact surfaces shall be wire brushed immediately prior to jointing.
4. Pipe Cutting shall be done without damage to the pipe with saw or abrasive wheel and shall be smooth, straight, and at right angles to the pipe axis. Ends of pipe shall be dressed and beveled to remove roughness and sharp corners.
5. Laying and Joining of PVC pipe shall be in accordance with AWWA C-900, AWWA C905, and AWWA C605, and with the pipe manufacturer's instructions. Laying and joining of ductile iron pipe shall be in accordance with AWWA C-600, Installation of Ductile-Iron Water Mains and their Appurtenances, and with the pipe manufacturer's instructions, unless specifically required otherwise by these Specifications. All Ductile Iron Water Mains shall be constructed with a Polyethylene Encasement tube as specified herein. The polyethylene encasement tube shall be secured circumferentially at 2 feet horizontal intervals with tape during installation.

Pipe shall be laid with bell ends facing in the direction of laying. Each pipe length shall be inspected for defects prior to being lowered into the trench. All pipe and fittings shall be carefully lowered into the trench piece by piece by means of pipe slings to prevent damage to the pipe and/or coating. Full lengths of pipe shall be installed except where connecting to appurtenances and fittings. The Contractor shall leave an appurtenance or fitting with a full length of pipe when ever possible.

During construction prior to filling and testing no water shall be allowed to run into or through the pipe.

During the course of construction, a suitable stopper shall be kept in the end of the pipe so as to prevent any dirt and or water from entering during the progress of the work at all times. Any dirt, loose material or cement mortar, which may accumulate in the pipe, shall be removed as the work progresses.

- a. Push-on Joints: The spigot end of field cut piping shall be cut square and then beveled. Joint surfaces shall be cleaned and lubricated immediately before completing the joint.

- b. Mechanical Joints: Joints shall not be over-tightened; if an effective seal is not obtained the joint shall be disassembled, cleaned thoroughly and reassembled. Where joint restraint devices are used with a mechanical joint, the holes shall be carefully aligned to permit installation of harness bolts. At mechanical joints, a beveled PVC spigot may not be used. Rather a non-beveled spigot shall be used for insertion into mechanical joint.
6. Protection of the Work: Once in place, the pipe shall have its open end plugged to prevent soil, water, or other matter from entering the pipe.
7. Pipe Deflection: Deflection or bending of the pipe or deflection of the pipe joint (bell and spigot) **shall not be permitted except as approved by the Engineer**. Changes in horizontal and vertical direction shall be achieved using standard fittings, fabricated fittings, Couplings, and/or high deflection pipe couplings specifically designed and approved for use in joint deflection.

The Engineer may approve deflection of 12 inch diameter or smaller pipe or pipe joints if the "Engineer of Record" specifically designed for the deflection and the deflection is approved in writing by the pipe manufacturer specifically for the project. A condition of approval is Lake Havasu City receiving a letter from the pipe manufacturer stating they have reviewed the proposed pipe or pipe joint deflections for (*state the project name and City project number*) and they approve and warranty the pipe for the proposed deflections. Deflection of pipe or pipe joints for diameters greater than 12 inch is strictly prohibited.

8. Fittings: Bends and tees shall be placed on a stable foundation, which may require the use of concrete pads of equal size or larger than specified for valves. Fittings shall be provided with thrust blocks, joint restraining devices, and polyethylene encasement as specified herein.
9. Couplings: Couplings shall be placed on a stable foundation and shall be wrapped in polyethylene encasement as specified herein. Couplings shall be approved by the pipe manufacturer for the use with the pipe and shall be installed according to the coupling manufacturer's recommendations.
10. Thrust Blocks: concrete thrust blocks shall be provided at tees, crosses, horizontal bends, plugs, caps, fire hydrants, and similar locations whether specifically indicated on the Drawings or not. Refer to the subsection "Joint Restraining Device Installations" for situations and fittings that require the use of joint restraints in-lieu of concrete thrust blocks.

Concrete thrust blocks shall have a thickness at the fitting equal to at least half the diameter of the pipe being installed but shall not be less than six (6) inches thick under any circumstances. They shall extend from the fitting to the undisturbed wall of the excavation. The Contractor shall insure that the concrete does not cover or render inoperable nuts or bolts on the fittings. All metal fittings, valves, or appurtenances shall be wrapped in polyethylene prior to pouring thrust blocks.

Concrete Thrust blocks shall be allowed to cure for 48 hours prior to activating the water main. If the water main needs to be activated prior to the concrete curing (48 hours) then the water main shall be restrained using joint restraining devices. Prior to backfilling, thrust blocks shall cure for a minimum of four hours.

Thrust Blocks shall be installed as shown on the drawings and shall meet or exceed the minimum volume or bearing area requirements as specified on the drawings or specifications for the water pressures and soil conditions.

In muck, peat, or similar weak soils, thrust loads shall be resisted by using joint restraining devices or by removal of the soil and replacement with a material of sufficient stability to resist thrust loads as determined by the Engineer.

Where prior approval of the Engineer is obtained, the Contractor may be able to substitute acceptable joint restraining devices for concrete thrust blocking. A condition of approval will be to address the potential corrosion issues associated with the use of joint restraints. The approval to substitute joint restraints is the Engineers decision and approval may or may not necessarily be granted even if the potential corrosion issues are addressed.

11. Joint Restraining Device Installations: Joint Restraining Devices are required for the following installations: Refer to the earlier section for the definition of "L" length for Joint restraining devices.

- a. All Valves 12 inches and larger and pipe joints within their corresponding "L" lengths shall be restrained,
- b. All High Pressure Valves (working pressures greater than 110 psi) and pipe joints within their corresponding "L" lengths shall be restrained,

- c. All Reducers/Increases and their corresponding "L" lengths shall be restrained,
- d. All Vertical Bends and pipe joints within their corresponding "L" lengths shall be restrained, and
- e. All Water Main Lowering and pipe joints shall be restrained.. Water Main Lowering restraint shall include restraining all joints within the fitting's corresponding "L" length plus restraining all pipe joints which lie between the start of the lowering and the end of the lowering, regardless whether or not the pipe joint is located within the fitting's "L" length.

All Joint Restraint Devices shall be double poly wrapped and taped per the specifications for polyethylene encasement. If cathodic protection anodes are used, double poly wrap shall not be required. The polyethylene encasement ends shall be taped around the entire pipe diameter.

Joint Restraining Devices shall be installed per the manufactures' recommendations and for the appropriate water pressures and soil conditions as shown on the drawings or specifications.

12. Tracer Wire: Tracer wire shall be installed along with all water pipes as described below:

The tracer wire shall be extended along with the water main. The wire shall be installed along the top of the pipe and shall be securely anchored to the pipe every 4 feet horizontally with an adhesive tape. The tracer wire shall be extended along all water main branches and hydrant leads as well. At fire hydrant leads two (2) tracer wires (the upstream tracer wire and the downstream tracer wire) shall be brought along the lead and brought to the surface at the fire hydrant. The upstream and downstream tracer wire at fire hydrants shall not be tied together as this is intended to allow independent tracing of the downstream and upstream main.

Tracer wire shall not be installed with copper water service lines.

Tracer wire shall be installed with PVC water services. Tracer wire installed with PVC service lines shall be installed in accordance with water main requirements except that the tracer wire shall be brought to the surface at a service line valve location. Do not connect the water service tracer wire to the tracer wire on the main. Tracer wire installed along service lines shall be independent of the tracer wire installed along the main. This allows for only tracing the service line.

At locations where the PVC water service is not being replaced entirely, the contractor shall splice the new tracer wire to the existing tracer wire at the point of reconnection. In instances where a PVC water service is not being replaced entirely and an existing tracer wire is not encountered, the Contractor shall coil approximately five (5) feet of wire at the reconnection location(s) to facilitate a future splice.

All tracer wire connections shall be accomplished through the use of "pig-tails". All splices and "pig-tails" shall be accomplished by stripping the wires to be connected, twisting the wires together, securing the connection by using an appropriately sized wire nut, and then preserving the splice or "pig-tail" by using a direct bury splice kit.

The main line tracer wire shall run continuous along the main(s) from fire hydrant to fire hydrant but shall not be continuous at fire hydrants. At fire hydrants two tracer wires shall be installed, one wire is the main line wire from downstream of the fire hydrant and the second wire is the main line wire going upstream of the fire hydrant. The main line tracer wire shall not be interconnected at the fire hydrant or at the main. This is intended to allow independent tracing of the downstream main from the upstream main and vice a versa. Service line tracer wire shall not be connected to the main line tracer wire.

As a condition of project acceptance, Water Division personnel shall be able to successfully electronically trace all newly installed tracer wire/water mains. Utility maintenance personnel should be able to connect to tracing wires at every Fire Hydrant location and energize all water mains between that fire hydrant and the surrounding fire hydrants. The contractor is responsible for coordinating conductivity testing with Water Division personnel prior to finish surfacing activities. If the tracer wire does not function as intended, the contractor shall repair the system to the satisfaction of the Engineer.

The Engineer shall inspect all underground splices and "pig tails" prior to backfilling.

13. Fire Hydrants and Auxiliary Valves: Fire Hydrants shall stand plumb and shall have their nozzles parallel with or at right angles to the street, with the pumper nozzle facing the street. At intersections, the pumper nozzle shall face the higher classification street. Hydrants shall be set with the bottom of the breaker flange 2 inches above the finished ground elevation as shown on the Standard Details, resulting in the centerline of the lowest

nozzle being at least 18 inches above finished grade. In no case shall hydrants be set closer than 4 feet from curb or edge of pavement, measured from outside of hydrant barrel to back of curb or edge of pavement..

The Contractor shall set each fire hydrant on a 8 inch x 12 inch precast concrete pad with a 4 inch thickness and shall place a minimum of 1/3 cubic yard of Aggregate Base around the lower part of the hydrant to at least six (6) in. above the drain port to provide a drainage area for the hydrant barrel. The Contractor shall insure that the drain port at the base of the hydrant is open to allow for the hydrant to drain properly when closed. Cast in place concrete may be used in lieu of the pre-cast pad if the hydrant lead is not charged for at least 48 hours and the drainage ports are maintained.

The hydrant barrel shall be poly wrapped to the ground surface and the poly wrap shall not cover up the weep holes.

An appropriately sized thrust block shall be installed between the hydrant valve chamber and the undisturbed trench wall. The thrust block shall meet the thrust block specifications herein.

An auxiliary valve matching the size of the fire hydrant lead and a valve box shall be installed on the fire hydrant lead. Auxiliary valves shall be installed as shown on the standard detail and shall be placed on a precast concrete block, or shall be fitted with a joint restraining device as approved by the Engineer. Cast in place concrete may be used in lieu of the pre-cast pad if the hydrant and hydrant lead are not charged for 48 hours, and 4 hours cure time is allowed before backfilling.

Tracer wire conduit shall be attached to the fire hydrant barrel section prior to backfill. Refer to the previous section for tracer wire installation requirements.

14. Valves: Valve interiors and adjacent piping shall be cleaned of foreign material prior to making valve to pipe connection. Pipe/valve joints shall be straight and without deflection. All valves shall be encased in polyethylene per AWWA Standard C105 and as specified herein and shall be placed on a precast concrete anchor block and centered on the valve. Valves shall be backfilled with Bedding Sand to one (1) foot above the valve. The Contractor shall check all operating mechanisms for proper functioning; valves, which do not operate easily or are otherwise defective shall be replaced at the Contractor's expense.

Valves placed on dead-ends of mains with less than the required "L" length of pipe extending beyond the valve shall be restrained using the appropriate "joint restraining devices".

15. Valve Boxes: Valve boxes shall be installed straight and plumb directly over the valve stem and shall not be placed in direct contact with the valve. The top of the valve box shall be placed flush to ¼ inches below flush with the surfacing in paved or graveled areas and 1 inch - 2 inches above finished grade in non-paved surfaced areas. Where the Drawings indicate that the future grade at the valve location will be higher or lower than the existing grade at the time of valve installation, the Contractor shall provide the correct combination of extension pieces so that the valve box can be adjusted to the future finished grade without replacing the valve box.

A Valve Box Adaptor shall be installed on the valve bonnet prior to installing the valve box.

When shown on the drawings or specified, tracer wire shall be secured to the valve box section prior to backfill.

16. Tapping Tees for taps 4 inches and larger: Where new 4 inch or larger service lines or mains are to be connected to a main, the Contractor shall furnish all material necessary for connection to the water main, as specified herein. The tapping tee shall be assembled in accordance with the manufacturer's instructions. Tapping sleeves shall be supported independently from the pipe prior to tapping and shall be provided with thrust restraint as specified for other fittings. All tapping tees, shall be poly wrapped.

17. Polyethylene Encasement: All buried metallic items including fittings, valves, valve boxes, fire hydrants, pipe, and accessories, shall be encased in 8-mil thickness sheet polyethylene per AWWA Standard C105. The polyethylene sheet shall be installed per AWWA C105 and taped using 3M Scotchwrap 50 or equal. The polyethylene shall fully encase the fitting and appurtenances. Excess material shall be neatly trimmed away and all seams shall be taped. The transition between the polyethylene sheet and PVC pipe or the DI poly tube shall be accomplished by, sealing the ends of the sheet and taping the material fully around the circumference of the pipe.

An exception to the polyethylene encasement requirement is when an anode cathodically protects the metallic item. In the case where the metallic item is protected by the use of an anode then the metallic item shall not be wrapped with polyethylene encasement.

18. Dewatering: If necessary dewatering shall be accomplished as identified in the special provisions.

3.6 Disinfection:

1. General:

Disinfection shall comply with the requirements of AWWA Standard C651, C605, and C600 and ADEQ Engineering Bulletin #8. All new water mains and appurtenances shall be disinfected before they are placed in service. All water mains taken out of service for inspecting, repairing, or other activity that might lead to contamination shall be disinfected before they are returned to service.

2. Preventative Methods:

The tablet method specified below may be used only if the pipes and appurtenances are kept clean and dry during construction. Therefore, the Contractor shall take precautions to protect the interiors of pipes, fittings, and valves against contamination. Pipe delivered for construction shall be strung so as to minimize the entrance of foreign material.

If dirt enters the pipe, it shall be removed and the interior of the pipe surface swabbed with a 1%-5% hypochlorite disinfecting solution. If, in the opinion of the Engineer, the dirt remaining in the pipe will not be removed by flushing, the Contractor shall clean the interior of the pipe by mechanical means, such as a hydraulically propelled foam pig. Following mechanical cleaning the Contractor shall flush the line achieving minimum flushing velocities of at least 30 ft/s and shall then disinfect the pipe using either the continuous-feed or the slug method. Flushing a completed main will not be allowed as a method of cleaning sediment allowed to enter the pipe during construction.

All openings in the pipeline shall be closed with watertight plugs when pipe laying is stopped at the close of the day's work or for other reasons, such as rest breaks or meal periods. If water accumulates in the trench, the plugs shall remain in place until the trench is dry. If, for any reason, the water main is flooded during construction, it shall be cleared of the floodwater by draining and flushing with potable water until the main is

clean. The section exposed to floodwater shall then be filled with a chlorinated potable water that, at the end of a 24-hour holding period, will have a free chlorine residual of not less than 25 mg/l. The chlorinated water shall then be flushed from the main and after construction is completed, the main shall be disinfected using the continuous-feed or slug method.

3. Disinfectant:

Unless specified otherwise in the Detailed Specifications or on the Drawings, or required by other provisions of this specification, disinfection shall be accomplished by the tablet method. The Contractor shall obtain the Engineer's approval prior to using a method other than the tablet method.

This method requires that the pipes and appurtenances be kept clean and dry. This method may not be used if the pipes and appurtenances are not kept clean and dry and in the event this happens, the Engineer must be contacted.

Tablets shall be 5-gram calcium hypochlorite tablets conforming to AWWA Standard B300 and shall contain between 65 and 70 per cent available chlorine. Tablets shall be fresh and shall be stored in a cool, dry, and dark environment to prevent loss of strength, which occurs upon exposure to the atmosphere.

Do not use calcium hypochlorite intended for swimming pool disinfection, as this material has been sequestered and is extremely difficult to eliminate from the pipe after the desired contact time has been achieved.

4. Dosage:

Unless otherwise specified, the Contractor shall place hypochlorite tablets in each section of water pipe installed, including the hydrant branch, according to the Table 1 below.

Table 1

**NUMBER OF 5-GRAM CALCIUM HYPOCHLORITE
TABLETS REQUIRED**

(50 mg/l Dose)

Length of Pipe Section (Ft.)	Diameter of Pipe (In.)						
	4	6	8	10	12	14	16
13 or less	1	2	2	3	5	6	8
13 - 18	1	2	3	5	6	8	11
18 - 20	1	2	3	5	7	9	12
20 - 30	2	3	5	7	10	14	18
30 - 40	2	4	6	9	14	18	24

For Pipes 18 inches and larger refer to drawings or detailed specifications for disinfection requirements. The Engineer of Record is responsible for establishing the disinfection requirements for pipes 18 inches and larger.

5. Placing Tablets:

Tablets shall be adhered to the inside top section of each pipe length using a food-grade adhesive, such as Permatex Form-A-Gasket No. 2 or Permatex Clear RTV Silicon Adhesive Sealant as manufactured by Loctite Corporation. Adhesives shall meet the requirements of a food-grade adhesive per either NSF/ANSI 51-2005: Food Equipment Materials or NSF/ANSI 61-2005: Drinking Water System Components – Health Effects. NSF/ANSI 61 lists several adhesives that are approved for drinking water contact. It is recommended to use an adhesive that sets quickly and isn't reactive with the water main's composition or with the disinfectant tablet. There shall be no adhesive on the tablet except on the broad side attached to the surface of the pipe. If the tablets are attached before the pipe section is placed in the trench, their position shall be marked on the pipe section to indicate the pipe has been installed with the tablets at the top.

6. Filling and Contact:

The water main shall be filled slowly so that the water velocity is no greater than **one foot per second**. Precautions shall be taken to assure that air pockets are eliminated. The water shall be allowed to stand in the pipe for at least 24 hours. Valves shall be positioned so that the strong chlorine solution in the treated main will not flow into water mains in active service. The chlorinated water shall remain in the pipe for at least 24 hours. The Contractor shall notify the Engineer at the end of the 24-hour retention period prior to flushing to allow the Engineer to check the chlorine residual in the pipe. If the chlorine residual is less than 25 mg/l, the Contractor shall, at his expense, disinfect the water main again by the continuous-feed method or the slug method, as approved by the Engineer.

7. Flushing:

Within 48 hours of the end of the 24-hour retention period, the Contractor shall flush the heavily-chlorinated water from the main until the chlorine concentration in the water leaving the main is no higher than that prevailing in the system or is less than 1 ppm as determined by the Engineer. In addition to the above requirements, a **minimum flushing velocity of 3 feet per second** and flushing duration of one minute per 100 feet of pipe being flushed shall be achieved per Table 2.

Flushing shall be done in accordance with AWWA C651. Flushing shall be accomplished through use of hydrants or temporary fittings installed for the purpose; flushing through corporations and/or water service lines is prohibited. The Contractor shall obtain the Engineer's approval prior to installing special fittings for flushing.

Flushing shall be conducted in such a way as to prevent contamination of existing water mains and/or water service lines and to minimize traffic and pedestrian hazards and nuisance conditions. When possible, flushing shall be to the nearest storm sewer or drainage way. Flushing to the sanitary sewer is prohibited.

The Contractor will be responsible for any damage to fish and/or aquatic life caused by the chlorine residual. If Chlorine reaches or is detected in a stream, river, or other waterway the Contractor will be in violation for that discharge. For more information, contact ADEQ (602) 771-2300. Refer to section below, "Disposal of Chlorinated Water" for additional information regarding neutralizing chlorine residual.

Table 2

REQUIRED FLOW AND MINIMUM FLOW DURATION TO FLUSH PIPELINES

Pipe Diameter (In.)	Flow required to produce 3.0 fps Velocity in Main* Gpm	Fire Hydrants Number of Fire Hydrants	Outlet Size (In.)	Minimum Flushing Duration (minutes per 100 feet of pipe)
4	120	1	2-1/2	1
6	280	1	2-1/2	1
8	480	1	2-1/2	1
10	740	1	2-1/2	1
12	1100	2	2-1/2	1**
14	1450	2	2-1/2	1**
16	1950	3	2-1/2	1**

Table 2 shows the rates of flow required to produce a velocity of 3.0 fps in pipes of various sizes and the minimum flushing duration per 100 feet of pipe length

For pipes 18 inches and larger refer to drawings or detailed specifications for flushing requirements.

* Requires a minimum 40-psi pressure in the main and the hydrant flowing to atmosphere.

** Assumes that the corresponding flow rate is being met.

Per AWWA C651, the Contractor shall sample for coliform bacteria contamination. After the water lines have been flushed, the contractor shall sample the lines. Two consecutive samples of water from the end of the disinfected/flushed line must be collected at least 24 hours apart. The samples must show the absence of coliform bacteria contamination before any taps may be made to the main or the main is activated and placed into service. Copies of all sample results shall be submitted to the Engineer within 48 hours of receipt thereof.

8. Disposal of Chlorinated Water:

When, in the opinion of the Engineer or Contractor, the potential exists for chlorinated water to reach a stream, river, or waterway, the Contractor shall apply a neutralizing chemical to the water to be wasted to neutralize thoroughly the chlorine residual remaining in the water as listed in Appendix B of AWWA Standard C651. The Contractor will be responsible for any damage to fish and/or aquatic life caused by the chlorine residual. If Chlorine reaches or is detected in a stream, river, or other waterway the Contractor will be in violation for that discharge. For more information, contact ADEQ (602) 771-2300

3.7 Pressure and Leakage Test for Mains and service lines 4 inches or larger:

1. General:

Pressure and leakage tests shall be performed on all newly installed water mains. The "Simultaneous Pressure and Leakage Tests" will be used unless otherwise specified. The testing methods specified in this section are specific for water pressure testing only; air pressure testing is prohibited due to the catastrophic nature of failure should failure occur.

2. Test Restrictions:

Per AWWA C605 the pressure shall be 150% of the working pressure at the point of test, but not less than 125% (or 150 psi, whichever is greater) of normal working pressure at the highest elevation, whichever is greater. Test pressure shall not exceed pipe, valve, or thrust-restraint design pressures and shall not vary by more than 5 percent (plus or minus) for the duration of the test. The duration of the hydrostatic test shall be a minimum of two (2) hours.

The Contractor shall anticipate the need to conduct multiple tests in areas of varying topography and shall conduct testing in such a manner and sequence that the pressure requirements indicated above are achieved.

3. Pressurization:

Before applying the specified test pressure, each valved section of pipe to be tested shall be slowly filled with potable water and all air expelled from the pipe, valves, fittings, and hydrants. Where City water is not available, the Contractor shall furnish sufficient potable water to fill and test the pipe. The specified test pressure, based on the elevation of the lowest

point of the section under test and corrected to the elevation of the test gauge, shall then be applied by means of a suitable pump connected to the pipe in a manner satisfactory to the Engineer and shall be sustained for the specified time.

The test pump shall be equipped **with two (2) accurate pressure gauges**, between the pump shut-off valve and water main being tested, both to show the line pressure reading during testing. When hydrants are in the test section, the test shall be made against closed hydrant valves. Pressure gauges shall have graduation marks, at minimum, for every 2 psi and be capable of interpreting pressure readings within 1 psi. The pressure reading deviation between the two pressure gauges shall not be greater than 2.0 psi. During the pressure test the pressure loss indicated between the two gauges shall not deviate more than 0.5 psi between the two gauges.

4. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within five (5) psi of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by the drop in pressure for a test section over a period of time.
5. Allowable Leakage for PVC Pipe and Ductile Iron Pipe:

The PVC pipe shall be pressure and leakage tested in accordance with AWWA C605. The Ductile Iron pipe shall be pressure and leakage tested in accordance with AWWA C600.

No pipe installation, PVC pipe or ductile iron pipe will be accepted if the leakage is greater than that indicated in Table 3.

**Table 3
ALLOWABLE LEAKAGE IN GALLONS
PER HOUR PER 1000 FT OF PIPE
(GPH)**

Pipe. Dia. (in.)	Average Test Pressure (PSI)					
	50 psi (gph)	100 psi (gph)	150 psi (gph)	200 psi (gph)	250 psi (gph)	300 psi (gph)
4	0.19	0.27	0.33	0.38	0.43	0.47
6	0.29	0.41	0.50	0.57	0.64	0.70
8	0.38	0.54	0.66	0.76	0.85	0.94
10	0.48	0.68	0.83	0.96	1.07	1.17
12	0.57	0.81	0.99	1.15	1.28	1.40
14	0.67	0.95	1.16	1.34	1.50	1.64
16	0.76	1.08	1.32	1.53	1.71	1.87
18	0.86	1.22	1.49	1.72	1.92	2.11
20	0.96	1.35	1.66	1.91	2.14	2.34
24	1.15	1.62	1.99	2.29	2.56	2.81
30	1.43	2.03	2.48	2.87	3.21	3.51
36	1.72	2.43	2.98	3.44	3.85	4.21

The above table is based on the equation $L = SD(P).5 / 148,000$ where

L= allowable make up water in gallons

D= nominal diameter of pipe in inches

P= average mainline test pressure (lb/ sq in) during mainline hydrostatic test

S= length of pipe tested

6. Acceptance shall be determined on the basis of allowable leakage. If any test of installed pipe discloses leakage greater than that specified in Table 3, the Contractor shall, at his own expense, locate and make approved repairs as necessary until the leakage is within the specified allowance. All visible leaks shall be repaired, regardless of the amount of leakage.

Any damaged or defective pipe, fittings, valves, hydrants, or joints discovered following the pressure test shall be repaired or replaced with approved material at the Contractor's expense, and the test shall be repeated until it is within the specified allowance.

7. Example - A pipe segment is required to be tested at 140 psi. At the start of the test, pressure gauge #1 indicates an initial pressure of 141 psi and pressure gauge #2 indicates an initial pressure of 143 psi. Both gauges are recording the test pressure within 2 psi and therefore the test may

proceed. After completing the two-hour test duration, pressure gauge #1 indicates a pressure of 134 psi and pressure gauge #2 indicates a pressure of 136.5 psi. The pressure drop for pressure gauge #1 is 7 psi and the drop for pressure gauge #2 is 6.5 psi. The two gauges record a pressure drop within 0.5 psi of each other therefore the deviation of the pressure reading between the two gauges is acceptable.

If the pressure test had indicated a pressure loss of less than 5 psi then the "Pressure and Leakage Test" would have been considered as passing. Because in this example, the pressure loss is more than 5 psi, the Contractor may elect to re-pressurize the system and repeat the two-hour test or the Contractor may elect to measure the quantity of water required to pressurize the pipe segment so that the pressure loss is less than 5 psi. For this example if the quantity of water required to pressurize the pipe segment so that pressure gauge #1 indicates a pressure of 137 psi (loss of 4 psi) and pressure gauge #2 indicates a pressure of 137.5 psi (loss of 4.5 psi), is within the quantity of water allowed per Table 3 then the test would be considered as passing without having to repeat pressure test for two-hours.

3.8 Water Main Closures and Temporary Service:

1. Water Main Closures shall be scheduled to minimize the inconvenience to the public. Consequently, water main closures shall be scheduled, between 9:00 A.M. and 4:00 P.M. Monday through Friday, when possible. Water main closures scheduled to begin prior to or continue beyond those times listed above, will require approval from the Engineer. In any case, water main closures will not be allowed until the Engineer gives his approval.

The Contractor shall provide notification of a proposed closure to the Water Division so that the Water Division has adequate time to hand-deliver the closure cards to affected properties at least 48 hours prior to closure of any water main, unless a shorter time of notice is approved by the Engineer.

2. Operation of Valves: Only City personnel shall operate valves on existing water mains. The Contractor may operate valves on newly installed water mains that are under his control, until such time as, they are accepted by the City for operation and maintenance.
3. Temporary water service for private residences affected shall be provided by the Contractor when the water main closure will exceed eight (8) hours. The Contractor shall provide temporary water service for

businesses upon request, regardless of the length of closure. When temporary service is to be provided to businesses, the Contractor shall obtain the name and phone number of a responsible contact person at each affected business and submit the information to the Engineer at least 48 hours prior to closure.

3.9 Abandonment and/or Salvage of Water Main and Appurtenances:

1. Water Mains:

The Contractor shall seal all open ends of water mains to be abandoned with a concrete plug having a length equal to the diameter of the pipe being plugged.

2. Fire Hydrants:

Fire hydrants and auxiliary valves are to be removed and salvaged, unless indicated otherwise on the drawings or Detailed Specifications, and shall be delivered by the Contractor to the City Utility Maintenance Shop in good working condition. Any damage to the hydrant and/or appurtenances as a result of removing, salvaging, and delivering, shall be repaired by the Contractor at no cost to the City.

3. Valves:

Unless indicated otherwise on the drawings or Detailed Specifications, valves are to be removed, salvaged, and delivered by the Contractor to the City Utility Maintenance Shop in good working condition. Any damage to the valve as a result of removing, salvaging, and delivering, shall be repaired by the Contractor at no cost to the City.

4. Valve Boxes:

The Contractor shall close the valve, remove and salvage the top sections of those water main valve boxes marked on the plans to be abandoned and shall deliver them to the City Utility Maintenance Shop. The resulting holes shall be backfilled and compacted to meet the requirements of these specifications and shall be resurfaced with the appropriate material; i.e. seed, gravel, asphalt, concrete, etc.

5. Others:

When the drawings indicate items are to be removed or salvaged, the Contractor shall deliver the items to the City Utility Maintenance Shop in good working condition. Any damage to the items as a result of removing, salvaging, and delivering , shall be repaired by the Contractor at no cost to the City.

Unless an item is indicated as salvaged, the item will be considered a Contractor obligation to remove and dispose of.

3.10 Service Lines and Fittings:

1. Permits, obtainable from the City, will be required for all connections to the City water system.
2. Service pipe: Copper pipe shall be laid with sufficient waving as to prevent rupture in settlement. A "goose-neck" shape shall be constructed in the copper pipe leading from the corporation stop. Polyethylene, PVC and ductile iron service pipe shall be laid as specified herein for water mains. Minimum cover depth for water service lines shall be four (4) feet. A six (6) foot horizontal separation shall be maintained between water service and sewer service lines. Tracer Wire shall be installed along with all Polyethylene and PVC service lines, as described in the specification section relating to tracer wire. Tracer Wire shall not be installed with copper service lines.
3. Service saddles shall be installed for all connections to water mains 2 inch and smaller. Unless specified otherwise on the Drawings or Detailed Specifications, the Contractor shall furnish and install all service saddles.
4. Corporation stops shall be provided by the Contractor. Corporation stops that are used to connect metal water services to metallic water mains shall be the isolator style. If a Contractor is installing a copper water service on private property but is not replacing the service to the main and the copper water services connects to a metallic water main then an insulating union for copper water services shall be installed near the curb stop or at the location where the new copper connects to the existing copper. This is only required for copper water services connecting to metallic mains.
5. Service lines larger than 2 inches diameter shall be connected to the main with either an appropriately sized tapping sleeve and valve or a ductile iron tee as specified for water main fittings elsewhere in these specifications.

6. Meter boxes shall be installed on all service lines and shall be located entirely within the public Right of Way. The top of the box shall be placed flush to ¼ inch below flush with the surfacing in paved or graveled areas and 1 - 2 inches above finished grade in non-traffic areas.

7. Water Service New Connections: Where new service lines are to be installed for undeveloped property or future buildings or additional services added to an existing building, the Contractor shall furnish all materials necessary for connection of new service lines to the water main.

The termination point shall be marked with a minimum four (4) foot long wood treated 2 by 4. The 2 by 4 shall be buried below the surface at least 2 feet.

Water Service New Connections for service lines 2 inches or larger shall be made as described in the section for tapping tees.

8. Water Service Reconnections: The Contractor shall furnish all materials necessary for reconnecting service lines existing prior to reconstruction of a water main. On City projects, all permits and tapping fees will be waived.

9. Inspection: All water service installations shall be inspected by the City prior to the Contractor backfilling the trench. The Contractor shall notify the City a minimum of four (4) hours prior to the time he needs the inspection. Any trench backfilled without being inspected and approved by authorized City personnel shall be re-excavated by the Contractor to expose the work for the required inspection. Discrepancies shall be corrected by the Contractor and re-inspected by City personnel.

3.11 Acceptance of Meter Valves and Main Valves:

As a condition for project acceptance, all meter valves and water main valves within the project boundaries shall be in proper operating condition. City personnel will inspect and operate each valve as part of the final inspection. The Contractor shall correct any deficiencies discovered during the inspection

PART 4 METHOD OF MEASUREMENT

A. Water Main and Service Line Pipe:

Installed pipe quantities shall be determined by measuring from centerline to centerline of all pipe and fittings. Measurements shall be to the nearest whole foot.

B. Water Main Fittings and Couplings:

Fittings furnished and installed shall be counted on a per each basis. Measurement for concrete thrust blocks, cable and rods, and other thrust restraint will not be made; such work shall be incidental to the respective work item.

C. Valves:

Valves shall be counted on a per each basis. Valve boxes shall be included with the valves as a complete unit.

D. Fire Hydrant Assembly:

Fire Hydrant Assembly will be counted on a per each basis. Hydrant, auxiliary valve, valve box and pipe between the auxiliary valve and hydrant shall be included with the assembly as a complete unit; no separate measurement and payment will be made for pipe between the auxiliary valve and the hydrant and for auxiliary valves and boxes.

E. Fire Hydrant Lead:

The water main pipe for the hydrant lead (branch) from the main to the Auxiliary Valve shall be paid for at the unit price bid for the appropriate size pipe.

F. Fire Hydrant Extensions:

Fire hydrant extension quantities shall be determined by measuring the vertical length of the extension. Measurement shall be to the nearest half foot.

G. Abandonments:

No separate measurement will be made for abandonment of water mains, valves and boxes, or salvaging hydrants, auxiliary valves and boxes; such work will be incidental to the project unless otherwise specified.

H. Water Service New Connections and Reconnections:

Water service reconnections and new water service connections will be counted on a per each basis.

The pipe used for reconnections and connections shall be measured and paid for under the bid item for water service pipe.

I. Service Saddles:

Service saddles furnished and installed will be counted on a per each basis.

J. Corporation Stops:

Corporation stops furnished by the Contractor will be counted on a per each basis. No measurement will be made for service corporation stops furnished by the City.

K. Meter Boxes & Service Termination fittings *Installed, Adjusted or Abandoned:*

Meter Boxes & Service Termination fittings *furnished and installed, adjusted, or abandoned will be counted on a per each basis.*

L. Water Main Encasement:

Measurement for water main encasement will be made on a per each basis, furnished and installed, for each encased crossing with lengths as noted on the Drawings.

M. Thrust Blocks and Joint Restraints:

No separate measurement will be made for thrust blocks or joint restraint devices, such work will be incidental to the pipe.

N. Polyethylene Encasement:

No separate measurement will be made for polyethylene encasement such work will be incidental to the pipe and fittings.

O. Water air release or blow off pits:

Water pits furnished and installed will be counted on a per each basis.

P. Tapping Tee (Includes sleeve and valve):

Tapping tees furnished and installed will be counted on a per each basis.

Q. Tracer Wire

Tracer wire access boxes, and all accessory items necessary for the installation of tracer wire shall be considered as incidental to the pipe installed.

R. Water Main Lowering:

Water main lowerings including, all materials, restraints, and Flowable Fill for the complete installation shall be included in the bid item for water main lowering. Water main lowerings shall be counted on a per each basis.

S. Abandon valve:

Abandon valve shall be counted on a per each basis.

T. Adjust Valve Box:

Adjust valve box shall be counted on a per each basis.

U. New Water Main Connections:

New water main connections shall be counted on a per each basis. The bid item, New Water Main Connections, is intended for use where a tapping tee cannot be used and where an in-line tee must be cut into an existing main or where a cap/plug with thrust block must be removed prior to connecting.

8.5 BASIS OF PAYMENT

A. Water Main Pipe:

Payment will be at the unit price bid for the appropriate size of water pipe, furnished and installed, including trenching, excavation, bedding material, compacting, backfilling, dewatering, sheeting or shoring, pressure and leakage testing, disinfection, and, for ductile iron pipe, polyethylene encasement. Unless otherwise specified, no extra payment will be made for excavation deeper than that required to provide minimum specified cover. The cost of providing temporary water service and plugging abandoned water mains shall be incidental to the project.

B. Water Main Fittings and Couplings:

Payment will be made at the unit price bid for the appropriate fitting, furnished and installed, including polyethylene encasement, and thrust blocks and/or restraints.

C. Valves:

Payment will be made at the unit price bid for the appropriately sized valve, furnished and installed, including valve box, polyethylene encasement, concrete pad, and thrust restraint.

D. Fire Hydrant Assembly:

Payment will be made at the unit bid price, complete, furnished and installed, including trenching, excavation and backfilling, dewatering, sheeting or shoring, and disinfection. Hydrant, auxiliary valve, valve box and pipe between the auxiliary valve and hydrant shall be included with the assembly as a complete unit; no separate payment will be made for pipe between the auxiliary valve and the hydrant and for auxiliary valves and boxes.

E. Fire Hydrant Extension:

When a fire hydrant extension is necessary due to no fault of the Contractor, as specified herein, payment will be made under the bid item for the fire hydrant extension per price bid.

However, if the hydrant could have been installed or ordered with the correct barrel length such that an extension was not necessary, the Contractor shall furnish and install a new Fire Hydrant with the correct barrel length. Hydrant Extensions in these cases will not be permitted.

F. Abandonments:

No separate measurement will be made for abandonment of water mains, valves and boxes, or salvaging hydrants, auxiliary valves and boxes; such work will be incidental to the project.

G. Water Service Lines:

Payment will be made at the unit price bid for the appropriately sized pipe, furnished and installed, including trenching, excavation and backfilling, compacting, dewatering, and sheeting or shoring. The cost for any

connections between the new service line and existing service lines shall be included in the unit price bid for the appropriate sized pipe.

H. Service Saddles:

Payment will be made at the unit price bid for the appropriately sized service saddle, furnished and installed.

J. Service Connection:

Payment for Contractor Service Connection as described in a previous section will be made at the unit price bid for the appropriately sized connection.

K. Service Termination:

Payment for Service Termination as described in a previous section will be made at the unit price bid for the appropriately sized termination furnished and installed.

L. Water Service New Connection:

Payment will be made at the unit price bid for connecting new water services up to two (2) inches in diameter to the new water main, including fittings necessary to connect the service line to the corporation stop. The cost of connecting water service lines two (2) inches or greater shall be included in the unit price bid for the fitting required to connect the service lines to the water main.

M. Water Service Reconnection:

Payment will be made at the unit price bid for reconnecting existing water services up to two (2) inches in diameter to the new water main, including fittings necessary to reconnect the service line to the corporation stop. The cost of reconnecting water service lines larger than two (2) inches shall be included in the unit price bid for the fitting required to connect the service lines to the water main.

N. Water Main Lowering:

Payment will be made at the unit price bid for lowering water main, including appropriate size pipe restraints, fittings, Flowable Fill, and incidentals necessary to complete the work. Water main lowering shall be that, which is physically lowered vertically with the horizontal location not changed more than five (5) feet from original.

O. Water Main Encasement:

Payment will be made at the bid price, furnished and installed, including materials, temporary blocking and restraint of the pipe, and incidentals necessary to complete the work.

P. Tapping Tees:

Payment for tapping tees will be at the bid price per each including sleeve and valve, complete and shall be considered full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the item.

R. Abandon Valve:

Payment for abandoned valve will be at the bid price per each, complete and shall be considered full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the item.

S. Adjust Valve and Valve Box:

Payment for adjusted valve will be at the bid price per each, complete and shall be considered full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the item.

T. New Water Main Connection:

Payment for new water main connection will be at the bid price per each, complete and shall be considered full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the item.

U. Tracer Wire System:

Tracer wire, tracer wire access boxes, and all accessory items necessary for the installation of tracer wire shall be considered as incidental to the pipe installed.

END OF SECTION