

SECTION W
WATER SYSTEM CONSTRUCTION

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SECTION W - WATER SYSTEM CONSTRUCTION

W.1 SCOPE:

These specifications for construction of water mains are intended to provide a minimum quality workmanship acceptable to the Town of Prosper and lack of any specifications not listed in this document in no way relieve the Contractor of full responsibility for providing a complete project of quality, finish appearance and satisfactory for operation.

The Contractor shall furnish and install all materials, labor, and equipment for constructing the work included in these specifications and as detailed on the plans.

Construction of all water systems shall comply with Texas Commission on Environmental Quality (TCEQ) Chapter 290 (Rules and Regulations for Public Water Systems) and American Water Works Association (AWWA), latest revision.

W.2 PROTECTION OF WORK:

When construction is stopped temporarily and at the end of the day's work, tight fitting stoppers or bulkheads shall be securely placed in or across the ends of all pipes.

The Contractor will be held responsible for the care of all work until final completion and acceptance, and he will be required to make good, at his own expense, any damage or injury it may sustain for any cause. He shall assume all risks from floods and casualties of every description and make no charge for damages from such cause.

W.3 MATERIALS:

The Contractor shall furnish and place materials meeting the requirements of these specifications, of the dimensions and types at the locations and elevations shown on the plans or established by the Engineer. All materials shall be approved by the Engineer before being installed and any of these materials placed before they are so approved shall be removed and replaced with approved materials.

W.3.1 Testing of Materials:

It shall be the sole responsibility of the Contractor to prove to the Engineer's satisfaction that materials furnished for the construction of water lines comply with these specifications.

Water pipe shall be tested at the factory to see that the pertinent specifications are satisfied. The manufacturer shall furnish a certificate and test reports for each carload, showing the conformity of his material with the specifications herein, and that each and every piece of pipe and fitting have been inspected for visible physical defects and defective pieces rejected.

W.3.2 Storage of Materials:

Materials delivered to the site of the work prior to their use shall be stored so as to cause the least inconvenience to the public, and in a manner satisfactory to the Engineer.

Materials that will deteriorate such as cement and mortar shall be stored in weather-tight buildings. Rubber gaskets shall be protected from direct sunlight, oils or contamination.

W.4 TRENCHING AND BACKFILL:

This item consists of excavating all necessary trenches for the water main and system construction and backfilling after the pipe has been properly laid, inspected, and tested. This work shall include the furnishing of all labor, materials, tools, equipment, and machinery necessary for clearing and removing from the site of the work, wherever located, all obstructions, trees, stumps, brush, vegetation, and debris, and all earth, rock, and other materials to be excavated; the removal of existing structures except where specifically paid for as separate contract pay items; the stripping or removal of top soil or sod to be piled separately from other excavated materials and later to be restored to its original place after backfilling is completed; the furnishing, placing, and maintaining of all sheeting, shoring and bracing necessary to protect the work and adjacent properties, all pumping, bailing, and draining necessary to keep the excavation free from seepage water, water from sewers, drains, ditches, creeks, and other sources; provision for the uninterrupted flow of sewers and surface waters during progress of the construction; the removal, after completion of the work, of all sheeting, shoring, and bracing not necessary to support the sides of the excavation; the satisfactory disposal of excess and unsuitable materials not required or which cannot be used for backfilling, tamping, compacting, and refilling after settlement of all excavated areas; the restoring of all streets, alleys, fences, right-of-way, and other lands or structures, private or public, damaged or occupied by the Contractor in the performance of the contract, to as good a condition as they were prior to the beginning of the work.

W.4.1 Classification:

Excavation in trenches for water line construction will be unclassified and will not be paid for separately but shall be included in the price bid per linear foot for the various sizes of pipe unless specific provision for separate payment is called for in the Special Provisions and on the Proposal Form.

Where no separate classification is provided, the price bid shall be on the basis of unclassified trenching, and the Contractor shall satisfy himself as to the material and conditions to be encountered.

"Unclassified" excavation will include all materials and conditions other than the above encountered in the excavation.

W.4.2 Construction Methods:

Trenches shall be excavated by trenching machine, backhoe or dragline, except in locations where hand trenching is required. The banks of trenches shall be vertical, to a point one foot (1') above the top of the pipe.

Trenches will be excavated to the lines and grades laid out by the Engineer or as shown on the plans. No change in locations of the lines is contemplated, but should any changes be made in the lines not materially altering the amount of character of the trenching to be done, the Contractor shall proceed with the changed alignment at the unit bid price. In case any change involves greater construction difficulties than the original alignment, the Owner and the Engineer will agree with the Contractor for extra compensation therefore, prior to the construction of the changed line or lines.

The width of the trench on each side of the pipe bell shall be eight inches (8"). Minimum width of the trench shall be twenty-four inches (24").

Trenches for water pipe shall be of such depth as to provide the cover as specified in Section W.12 of these specifications.

The excavation shall not advance more than three hundred feet (300') ahead of the completed and backfilled pipeline. Pipe shall be laid in all trenches that have been opened at the end of each day's work, unless the Contractor secures written permission to do otherwise from the Engineer.

If the bottom of the trench becomes an unstable foundation for the pipe through the neglect of the Contractor to adequately shore or dewater, the Contractor will be required to remove the unstable material and backfill the trench to the proper grade with approved compacted gravel, and no extra compensation will be granted for this material or work.

Also, if the trench is inadvertently excavated deeper than necessary it shall be backfilled to the proper grade with approved compacted gravel at the Contractor's expense.

However, if the undisturbed material encountered at the grade depth constitutes in the opinion of the Engineer, an unstable foundation for the pipe, the Contractor will be required to remove such unstable material and backfill the trench to the proper grade with approved compacted material. Compensation will be made to the Contractor in accordance with a mutually agreed upon cost per cubic yard.

The Contractor shall excavate all trenches, including work necessary in working around existing pipe lines or other obstructions. The Contractor shall give notice to the Owners of any such lines or obstructions in order that they may have time to take the necessary precautions for protecting their property. The Contractor shall be responsible for protecting the Owner from any damage from his operations in such work.

In rock, excavation shall be carried six inches (6") below the bottom of the pipe and gravel, thoroughly tamped, shall be used for backfilling to the grade of the bottom of the pipe line as specified by the specific embedment required.

After inspection of pipelines has been finished on any completed portion of the work the trench may then be backfilled. Backfilling shall be accomplished in compliance with the applicable portions of these specifications.

W.4.3 Sheeting, Shoring, and Bracing:

The sides of all excavations shall be sheeted, shored, and braced in accordance with OSHA Regulations and installed by the Contractor's "competent person" so as to try to prevent slides, cave-ins, settlement, or movement of the banks and to maintain the excavation clear of obstructions that will in any way hinder or delay the progress of the work. In wet, saturated, or flowing materials, when it is necessary to install tight sheeting or cofferdams, wood or steel sheet piling of a design and type approved by the Engineer, who designed the trench safety plan, shall be used.

All sheet piling, shoring and bracing shall have sufficient strength and rigidity to withstand the pressure exerted and maintain the sides of the excavation properly in place and protect all persons or property from injury or damage. When excavations are made adjacent to existing building or other structures or in paved streets, particular care should be taken to adequately sheet, shore, and brace the sides of the excavation to prevent undermining of, or settlement beneath, the structures or pavement. Underpinning of adjacent structures or pavement shall be done by the Contractor at his own cost and expense in a manner satisfactory to the Engineer and

when required by the Engineer. The pavement shall be removed, the void satisfactorily refilled and compacted, and the pavement replaced by the Contractor; the entire expense of such removal and subsequent replacement thereof shall be borne by the Contractor. Sheeting, shoring and bracing shall not be left in place unless otherwise provided for in the contract or authorized by the Engineer. The removal of sheeting, shoring, and bracing shall be done in such manner as not to endanger or damage either new or existing structures, private or public properties, and so as to avoid cave-ins or sliding of the banks. All holes or voids left by the removal of the sheeting, shoring, or bracing shall be immediately and completely filled and compacted with suitable materials. Sheeting, shoring, and bracing ordered left in place by the Engineer will be paid for at the unit price bid for this item, when such pay item is provided. In the event no separate pay item is provided, then the cost of sheeting, shoring and bracing is to be included in such items as are provided.

W.4.4 Pumping, Bailing and Draining:

The Contractor shall immediately remove all surface or seepage water from sewers, drains, ditches, and other sources which may accumulate during the excavation and construction work by providing the necessary underdrains or otherwise and by doing the necessary pumping, bailing or draining. The Contractor shall have available at all times sufficient equipment in proper working order for doing the work herein required.

All water removed from excavations shall be disposed of in an approved manner so as not to create unsanitary conditions nor to interfere unduly with the use of streets, private driveways, or entrances. Pumping, bailing, draining, underdrains, ditches, etc., shall be considered as incidental work and will not be bid for as separate items but their cost shall be included in the contract prices bid in the Proposal for the various units of excavation measure.

W.4.5 Support of Existing Pipes Across Trench:

It shall be the responsibility of the Contractor to protect and support all water, sewer, gas, and other conduits crossed by the excavation or work to be performed by him or to arrange for their temporary removal and subsequent replacement. All expense incidentals to this phase of the work shall be borne by the Contractor.

W.4.6 Disposal of Excavated Materials:

Excavated materials, so far as needed and of a suitable character, shall be piled adjacent to the work to be used for backfilling as required. Excavated materials unsuitable for the backfilling or in excess of that required for backfilling shall be disposed of in an approved manner at locations designated on the plans or approved by the Engineer. Desirable top soil, sod, etc., shall be carefully piled separately and replaced in its original position when required. Excavated materials shall be handled at all times in such a manner as to cause a minimum of inconvenience to public travel and to permit safe and convenient access to private and public property adjacent to or along the line of the work. In parkways and easements where it is necessary to deposit excavated materials on lawns during the work, burlap or canvas shall be placed on the lawn to prevent contact between excavated materials and the lawn.

W.4.7 Protection of Trees, Plants, Shrubby, etc.:

Where trees, plants, shrubby, etc., are adjacent to the line of the work and are not to be removed or removed and replaced, the Contractor shall protect such trees, plants, shrubby, etc., by substantial wooden boxes and guards and shall not permit machinery or employees to scrape, tear the limbs from or damage or attach guy cables to them, and if, in the opinion of the Engineer, such trees, plants, shrubby, etc., would be damaged by machinery, etc., hand

excavation may be required. The Contractor shall be responsible for all damages to adjacent trees, plants, shrubbery, etc.

W.4.8 Use of Explosives:

The plans and specifications do not require the use of explosives. After approval by the Engineer, should the Contractor elect to use explosives in the prosecution of the work, utmost care shall be exercised so as not to endanger life or property and the Contractor shall use only such methods as are currently utilized by persons, firms, or corporations engaged in a similar construction business. The Contractor shall be solely responsible for the determination as to whether explosives shall be used and for any result from the use of explosives and shall indemnify and hold the Owner whole and harmless against any claim or damage or injury to persons or property, real or personal, as the result of the use of explosives by the Contractor or any subcontractor. The Contractor shall furnish the Owner with evidence of insurance sufficient to cover any such possibility, in which insurance shall either include the Owner as an insured or be of such character as to protect the Owner.

All explosives shall be stored in a safe and secure manner, under the care of a competent watchman at all times, and all such storage places shall be marked clearly "DANGEROUS - EXPLOSIVES". The method of storing and handling explosives and highly inflammable materials shall conform with Federal and State laws, City ordinances, and Fire Department regulations, and to the satisfaction of the Engineer.

The Contractor shall notify each utility company having structures in proximity to the site of the work of his intention to use explosives, and such notice shall be given sufficiently in advance to enable the companies to take such steps as they deem necessary to protect their property from injury. Such notice shall not relieve the Contractor of responsibility for any damage resulting from his blasting operations.

W.4.9 Jacking, Boring or Tunneling:

This specification shall govern for the provision of the required opening for the installation of conduits by the methods of jacking, boring, or tunneling as shown on the plans and in conformity with this specification.

W.4.9.1 Materials:

The encasement and carrier pipe shall be of the type and strength as indicated on the plans.

W.4.9.2 Construction Requirements:

Where encasement or carrier pipe is required to be installed under railroad embankments or under highways, streets, or other facilities by jacking, boring or tunneling methods, construction shall be made in a manner that will not interfere with the operation of the railroad, highway or other facility, and will not weaken or damage any embankment or structure. During construction operations, barricades and lights to safeguard traffic and pedestrians shall be furnished and maintained, as directed by the Engineer until such time as the backfill has been completed and then shall be removed from the site.

The drilling of pilot holes for the alignment of pipe prior to its installation by jacking, boring or tunneling will not be a requirement but may be necessary to maintain grade. The drilling of pilot holes will be considered as incidental work and the cost thereof shall be included in such contract pay items as are provided in the proposal and contract. The Contractor shall take the proper precautions to avoid excavating earth or rock or shattering rock beyond the limits of excavation needed to install the conduit. All damages by excavating and blasting, either to surface or subsurface structures, shall be repaired or replaced by the Contractor at his own cost and expense.

The removal of any obstruction that may be found to conflict with the placing of this pipe will not be measured for payment or paid for as a separate contract pay item. The removal of any such obstruction will be included in such contract pay items as are provided in the proposal and contract. The Contractor shall dispose of all surplus materials at his own cost and expense at sites approved by the Engineer.

W.4.9.3 Construction by Jacking:

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

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

Heavy-duty jacks suitable for forcing the pipe through the embankment shall be provided. In operating jacks, even pressure shall be applied to all jacks used. A suitable jacking head not less than six inches (6") larger than the outside diameter of the pipe, usually of timber, and suitable bracing between jacks and jacking head shall be provided so that pressure will be applied to the pipe uniformly around the ring of the pipe. The jacking head shall be of such weight and dimensions that it will not bend or deflect when full pressure is applied at the jack. The jacking head shall be provided with an opening for the removal of excavated material as the jacking proceeds.

A suitable jacking frame or backstop shall be provided. The pipe to be jacked shall be set on guides which are straight and securely braced together in such manner to support the section of the pipe and to direct it in the proper line and grade. All timber and other materials used in the construction of the jacking assembly will be of such quality and dimensions that they will withstand all stresses to which they are subjected in such a manner as to insure even pressures on the pipe during jacking operations. The whole jacking assembly shall be placed so as to line up with the direction and grade of the pipe.

As the jacking proceeds, the embankment material shall be excavated slightly in advance of the pipe in such a manner to avoid making the excavation larger than the outside diameter of the pipe, with the excavated material being removed through the pipe. The excavation for the underside of the pipe, for at least one-third (1/3) of the circumference of the pipe, shall conform to the contour and grade of the pipe. The excavation for the top half (1/2) of the pipe shall conform closely to the outside diameter of the pipe and a clearance greater than two inches (2") will not be permitted. All voids between the pipe and the earth will be filled with grout 1:7 minimum proportioned mix grout with five percent (5%) to forty percent (40%) air entrainment. Grout holes may be provided in the pipe or grouting may be made through drill holes from the

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

All carrier pipe installed by jacking shall be supported by quarter point cradle of 2000 psi concrete across the jacking pit and to the first joint in the ditch section on each end.

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

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

Any pipe damaged in jacking operations shall be repaired or removed and replaced by the Contractor at his entire expense. The pits or trenches excavated to facilitate jacking operation shall be filled immediately after the jacking of the pipe has been completed unless an encasement only has been installed; in which case, the trenches and pits shall be left open until the carrier pipe has been laid through and manholes have been built if required. The pits or trenches will then be backfilled in accordance with the location and conditions as are covered elsewhere in these specifications.

If a carrier pipe is laid through an encasement pipe the bedding of crushed rock, concrete, grout or granular material, if any, will be considered a part of the unit price of the jacking operation.

W.4.9.4 Construction by Boring:

The hole shall be bored mechanically with a suitable boring assembly designed to produce a smooth, straight shaft and so operated that the completed shaft will be at the established line and grade. The size of the bored hole shall be of such diameter to provide ample clearance for bells or other joints. All carrier pipe installed by boring shall be supported by quarter point cradle of 2000 psi concrete across the boring pit and to the first joint in the ditch section. All voids will be grouted with a 1:7 minimum proportioned mix with five percent (5%) to forty percent (40%) air entrainment, and will be considered a part of the unit price of the boring operation.

In addition to the requirements stated above, the applicable provisions of Section W.4.9.3, "Construction by Jacking", in regard to the construction of trench, tolerance in line and grade, method of operation, backfilling, etc., shall govern for construction by boring.

W.4.9.5 Construction by Tunneling:

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

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

illumination of the tunnel construction, for illumination of completed portions of the tunnel used for passage, and wherever lighting is needed for inspection of the work. Sufficient number of lamps shall be used to properly illuminate the work and all wiring for electric power and lights shall be installed and maintained in a safe and secure manner in accordance with the current applicable Electrical Code.

The Contractor shall maintain the tunnel air in a condition suitable for the health of the workmen and sufficiently clear for surveying operations. A sufficient supply of fresh air shall be provided and maintained at all times in all underground places and provisions shall be made for the quick and complete removal of gases and dust resulting from blasting or other tunnel operations. Except when unnecessary due to natural ventilation, artificial ventilation shall be maintained in the tunnel by ventilating plants of ample capacity operated when needed to meet the preceding requirements.

If required by the plans or as required for safety, suitable steel or timber sheeting, shoring and bracing shall be used to support the sides and roof of the excavation. Supports may be left in place provided that they clear the encasement or carrier pipe. No separate payment will be made for supports left in place.

Nothing contained herein shall prevent the Contractor from placing such temporary or permanent supports as they do not deem necessary, nor shall it be construed as relieving the Contractor from his full responsibility for the safety of the work, and for all damages to persons and property.

If the tunnel is to be lined with concrete as a monolithic structure, then the over-break, if any, or voids will be poured with concrete of the required strength as detailed on the plans. If the strength is not indicated, the twenty-eight (28) day strength will be a minimum of 3000 psi. The Contractor will not be compensated for over-breaks.

No pipe shall be placed until the foundation is in a condition satisfactory to the Engineer. Tunnel dimensions shown on the plans are minimum dimensions and any excess excavation and subsequent backfill, concrete or grout fill, shall be at the expense of the Contractor. The pipe shall be laid in the tunnel true to the line of grade. Tolerance in line and grade shall be as specified in Section W.4.9.3., "Construction by Jacking."

Unless otherwise indicated or specified, the entire void between the outside of the pipe and the tunnel walls or the inside face of the tunnel lining shall be backfilled with concrete having a minimum compressive strength of 3000 psi at twenty-eight (28) days or 1:7 minimum proportioned mix grout with five percent (5%) to forty percent (40%) air entrainment. No concrete or grout shall be placed around the pipe unless the permanent sheeting, bottom, sides and roof of the tunnel are in a condition satisfactory to the Engineer. The minimum thickness of concrete or grout backfill shall be maintained throughout. Concrete required for backfill in excess of the minimum dimensions shown on plan will be at the entire expense of the Contractor.

All pipe damage during construction operations shall be repaired or removed and replaced by the Contractor at his entire expense.

W.4.9.6 Joints:

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

W.4.10 Protection of Buildings:

The Contractor shall, at his own expense, shore up and otherwise protect any building or other structure which may, in the opinion of the Engineer, be endangered during the work, and he shall restore all buildings, culverts, fences, walls, or other properties disturbed during his work to a condition similar or equal to that existing before his operations.

The Contractor shall be responsible for any injuries to persons and property, for all damages to any pipe, conduit, sewer, or other structures injuriously affected by the work. The Owner shall not be liable therefore.

W.4.11 Crossings to be Kept Open:

At such street, railroad, and all other crossings as may be designated by the Engineer, the trenches are to be filled in such a manner as to prevent any serious interruption of traffic upon the roadway or sidewalks. The cost thereof shall be borne by the Contractor.

W.4.12 Protection of Unfinished Work:

Before leaving work for the night, during a storm, or at other times, care must be taken to protect and securely close the unfinished end of the pipe. Any earth or other materials that may find entrance into the pipe through any such open or unplugged end of the pipe must be removed at the Contractor's expense.

W.4.13 Lights and Guards:

The Contractor must provide and maintain adequate detours around the work under construction. The Contractor shall provide lights, warning signs, and/or watchmen in accordance with the Texas Manual on Uniform Traffic Control Devices (TMUTCD), latest revision, to provide adequately for the safety of the public.

W.4.14 Backfill:

Excavation shall be backfilled only with approved materials. The placing of backfill material shall not begin until approval has been given by the Engineer and shall be done immediately when so ordered by the Engineer.

Backfilling shall be brought up to an elevation slightly above the original ground level to allow for subsequent settlement. The top surface or slopes of all backfill shall be neatly graded off in a workmanlike manner, and where select topsoil, sod, or other material is removed and piled separately, such material shall be carefully replaced in a manner satisfactory to the Engineer.

W.4.14.1 Backfill Material:

Backfilling shall be done with good sound earth. Broken concrete, rock, bituminous pavement, or other lumpy material shall not be used in the backfill except as the lumps are small and their dispersal in the backfill is made in the upper section in a manner satisfactory to the Engineer. Materials of a perishable, spongy, or otherwise improper nature shall not be used in backfilling. Where good sound earth is not available from the excavated material, gravel cushion and/or granular backfill material will be used for the initial backfill operation to a point twelve inches (12") above the top of the pipe. Gravel cushion and/or granular backfill material will not be required when concrete encasement is specified or used around the pipe. No backfill shall be removed. Sheeting, shoring and bracing shall be pulled and removed during the progress of the backfilling in a manner satisfactory to the Engineer.

W.4.14.2 Concrete Encasement (Class F4 Embedment):

The pipe shall be supported by concrete block.

Concrete encasement when required, shall be composed of a free flowing material consisting of small stone, pea gravel, limestone chat, or pit run sand and gravel. The material shall be free from sticks, lumps, stones, and organic matter. Concrete encasement shall be poured either wet or dry as may be directed by the Engineer. Concrete encasement shall have an average compressive strength at twenty-eight (28) days equal to or greater than 3000 psi.

When concrete encasement backfill material is specified or ordered by the Engineer to be poured DRY, the Contractor shall place this material on each side of the pipe for the pipe for the full width of the trench using shovels to cut the material back under the pipe and shall be tamped to a height of six inches (6") minimum above the pipe to receive final backfill.

Care must be exercised not to dislocate or disturb the grade or alignment of the pipe. If ordered by the Engineer to be poured WET, caution and care must be used not to float the pipe out of place. In the event pipes are floated out of the proper position, they shall be removed and relayed at the expense of the Contractor

W.4.14.3 Cement Stabilized Backfill:

Where backfill material shown or called for on the plans is cement stabilized the material shall extend from the top of the standard embedment to the natural ground elevation and include the entire width of the trench. Cement stabilized backfill shall contain a minimum of two (2) sack mix (per yard of earth).

W.4.14.4 Embedment:

In the construction of water lines, the trench shall be excavated to a minimum depth of six inches (6") below the grade of the outside of the pipe.

On water line construction, when, in the opinion of the Engineer, the subgrade material encountered at grade is soft, spongy, and unsuitable, it shall be removed to such a depth that the replacement thereof with firmly tamped crushed rock or natural gravel will provide an unyielding, stable foundation.

Class F1 Embedment: the trench shall be filled with Standard Crushed Rock or Natural Gravel up to 1/2 the outside diameter of the pipe. (Standard PVC Pipe)

Class F3 Embedment: the trench shall be filled with Standard Crushed Rock or Natural Gravel up to 1/6 outside diameter of pipe. (Ductile Iron Pipe)

A. Rock

The stone used in cushion shall consist of durable particles of crushed rock and shall be free from lumps, stones over two inches (2") in diameter, free from frozen material or injurious amounts of salt, alkali, loam, vegetable or other organic matter. It shall have a wear of not more than forty percent (40%) when tested in accordance with Texas SDHPT Test Method TEX-410-A. Gradation is provided in table below:

B. Gravel

The gravel used in cushion shall consist of uncrushed stones meeting the requirements of wear as referenced in Section W.4.14.4(A) above. The material shall be washed and screened and not have by weight more than one percent (1%) organic matter, clays or loam and not more than five percent (5%) by weight of any one of or combination of slate, shale, schist or soft particles of sandstone. Gradation is provided in table below:

When tested by standard laboratory methods, gravel cushion embedment shall meet the following requirements for percentage by weight as stated in the Texas State Department of Highways and Public Transportation Standard Specifications for Construction of Highways, Streets and Bridges.

TABLE – GRAVEL CUSHION EMBEDMENT

STANDARD CRUSHED ROCK (Aggregate Grade 4 or Size No. 57 ASTM C 33)	
<u>Sieve Size</u>	<u>Percent</u>
Retained on 1-1/2 inch	0%
Retained on 1 inch	0% to 5%
Retained on 1/2 inch	40% to 75%
Retained on No. 4	90% to 100%
Retained on No. 8	95% to 100%
NATURAL GRAVEL	
<u>Sieve Size</u>	<u>Percent</u>
Passing 1-1/2 inch	100%
Retained on 3/4 inch	100%

Sub grades that have been allowed to become unstable by neglect of the Contractor, by improper drainage or lack of drainage, when in the opinion of the Engineer, the condition was caused by the neglect or fault of the Contractor, the Engineer shall order the Contractor to remove the unstable subgrade and replace the same with gravel at the expense of the Contractor, and no extra compensation will be allowed.

W.4.15 Initial Backfill:

After pipe has been laid and the joints have hardened to such an extent that they will not be damaged by backfilling operation, the pipe lines shall be backfilled in accordance with ASTM D-698 as follows:

Class F1 Embedment: Select or granular material compacted to ninety-five percent (95%) Standard Proctor Density a minimum of twelve inches (12") over the top of the pipe or as required by the Engineer.

Class F3 Embedment: Select or granular material compacted to ninety-five percent (95%) Standard Proctor Density a minimum of six inches (6") over the top of the pipe or as required by the Engineer.

Sand shall consist of clean, hard, durable, uncoated grains, free from lumps and organic material. All particles must pass a No. 8 sieve.

Any special backfill where shown on the plans shall replace the backfill procedure shown herein.

Detectable Metallic Tape ("Blue-Caution Buried Water Below" or approved other) shall be installed after initial backfill on approximate centerline of pipe prior to final backfill.

W.4.16 Final Backfill:

The final backfilling operation shall be in accordance with ASTM D-698 and one of the following methods used for any of the initial backfill procedures. All final backfill material shall be less than six-inch (6") diameter.

- A. The remainder of the backfill shall be native material placed in uniformly compacted layers not exceeding six inches (6") in loose depth and hand or mechanically tamped in a manner approved by the Engineer to ninety-five percent (95%) Standard Proctor Density.
- B. With City approval where an existing street or driveway surface has been cut (asphalt pavements shall be saw cut before excavation), the following procedure is to be used in backfilling and replacing the pavement (unless otherwise shown on the plans):
 1. The top twenty-four inches (24") of the trench shall be filled with crushed stone flex-base.
 2. In not more than seventy-two (72) hours after backfill of the pavement cut is completed, unless otherwise approved by the Engineer, the Contractor shall remove the gravel backfill to a point and pour a minimum six-inch (6") thick concrete slab extending twelve inches (12") beyond the trench width. The slab shall be covered with twelve inches (12") flexible base (95% Standard Proctor Density) and then place fine graded surface course hot mix asphalt concrete, which, when compacted, will be not less than one and one-half inches (1-1/2") thick or equal to the adjacent asphalt.
- C. Where concrete pavement is cut, the Town of Prosper Representative and the Contractor shall meet to determine the amount of removal.

W.5 POLYVINYL CHLORIDE (PVC) PIPE INSTALLATION:

Polyvinyl chloride (PVC) pipe may be installed for water mains in the public water utility system.

W.5.1 Polyvinyl Chloride (PVC) Pipe and Fittings:

PVC pipe shall be new, manufactured in the United States of America and shall be blue in color. PVC pipe shall conform to AWWA C900 or C905. PVC water pipe shall be listed by Underwriters Laboratories and approved for use in cities and towns of Texas by the State Board of Insurance. The rigid PVC pipe shall bear the seal of approval (or 'NSF' mark) of the National Sanitation Foundation Testing Laboratory for potable water pipe. Provision must be made for contraction and expansion at each joint with a rubber ring, and an integral thickened bell as part of each joint. Pipe and fittings must be assembled with a non-toxic lubricant in accordance with pipe manufacturer's recommendations. Pipe shall be made from NSF approved Class 12454 PVC compound conforming to ASTM resin specification D1784. PVC pipe shall be a minimum Class 150 (DR18). Laying lengths shall be twenty feet + one inch (20' + 1").

W.6 DUCTILE IRON PIPE INSTALLATION:

W.6.1 Ductile Iron Pipe :

Ductile Iron Pipe shall be new, manufactured in the United States of America and designed in accordance with AWWA Specifications (C150) (ANSI A21.50) using 60,000 psi tensile strength, 42,000 psi yield strength and ten percent (10%) elongation. Pipe shall be designed for a minimum 150 psi water pressure plus 100 psi surge, with the trench conditions depth of cover and backfill as specified and blocks, with a two (2) to one (1) safety factor.

Ductile Iron Pipe shall be manufactured in accordance with AWWA Specification C151 (ANSI A21.51) in metal or sand lined molds.

Ductile Iron Pipe shall be cement lined in accordance with AWWA Specification C104 (ANSI A21.4).

The pressure rating, thickness class, net weight of pipe without lining, length of pipe and name of manufacturer shall be clearly marked on each pipe.

Ductile Iron Pipe may be mechanical joint, Fastite, Bell-Tite or TYTON per AWWA Specification C111 (ANSI A21.11). Mechanical joints to be furnished complete with accessories. Bolts and nuts shall be Stainless Steel or Cor-ten.

W.6.2 Fittings for Ductile Iron Pipe:

Fittings shall be Ductile Iron per AWWA Specification C153 (ANSI A21.53) or AWWA C110 (ANSI 421.10). Mechanical Joint, or Push-on Joint, with a working pressure of 350 psi for 4" through 24" and a working pressure of 250 psi for greater than 24" fittings. Mechanical Joint Fittings shall be manufactured in accordance with AWWA Specification C110 (ANSI A21.10) with Mechanical Joints manufactured in accordance with AWWA Specifications C111 (ANSI A21.11) complete with Stainless steel bolts and nuts (US alloy or approved other). Push-on Fittings shall be manufactured in accordance with the applicable portions of AWWA Specification C110 (ANSI A21.10) and AWWA C111 (ANSI A21.11). Joints to be in accordance with the respective manufacturer's standard, gaskets for push-on joint fittings must be interchangeable with those furnished with the pipe. Compact fittings shall be manufactured in accordance with AWWA C153 (ANSI A21.53) for 3" through 24" and 54" through 64" pipe. Fittings shall be cement lined in accordance with AWWA Specification C104 (ANSI A21.4).

W.7 CONCRETE CYLINDER PIPE INSTALLATION:

Concrete cylinder pipe, fittings, specials, and valves are to be installed at locations shown on the plans.

Unless otherwise indicated, pipe in trenches shall be laid to the grade shown on an even grade from point to point for which elevations are furnished. The grade line shown on the plans is the invert or flow line. The Contractor shall establish the grade line in the trench or excavation from grade stakes established by the Engineer.

W.7.1 Pipe Handling:

Pipe, fittings, valves, and other accessories shall be hauled to and distributed at the site of the project by the Contractor; they shall at all times be handled with care to avoid damage. In loading and unloading they shall be lifted by hoists or cranes as specified below or rolled on skid ways in such manner as to avoid shock.

Under no circumstances shall pipe be dropped.

Pipe handled on skid ways must not be skidded or rolled against pipe already on the ground. Pipe shall be placed on the site of the work parallel with the trench alignment and with bell ends facing the direction which the work will proceed unless otherwise directed.

Proper implements, tools, equipment, and facilities shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, fittings, specials, valves, etc., shall be lowered into the trench by means of a "side boom", crane, or other suitable machine and shall not be rolled or dumped into the trench. The "side boom", crane, etc., shall be of a sufficient size for handling the pipe, shall lift and lower the pipe at a slow rate of speed, and shall be capable of stopping the lifting operation at any point without producing a shock or otherwise jerking or vibrating the pipe. The hoisting cable pipe clamp shall be connected to the pipe in such a manner so as to prevent damage to the coating. The method of connection shall be subject to the Engineer's approval. Before lowering into the trench, each joint of pipe shall be inspected and any unsound or damaged pipe shall be rejected.

The pipe shall be kept clean during the laying operation and free of all sticks, dirt, and trash, and at the close of each operating day the open end of the pipe shall be effectively sealed against the entrance of all objects and especially water. No pipe shall be laid in water or when the trench conditions or the weather are unsuitable for such work, except in an emergency and then only upon permission of the Engineer.

All pipe shall be laid accurately to established lines and grades with valves and fittings at the required location and with joints centered and spigots home. Line and grade stakes will be provided by the Engineer.

Where it becomes necessary to make deflections in the line of the pipe, sections of pipe with beveled ends up to 5° of fabricated fittings shall be used. Minor deflection of the line of the pipe may be obtained in the pipe joints; however, the maximum joint opening caused by such deflection shall not exceed three-quarter inch (3/4") for sixteen-inch (16") pipe and larger. Field cuts of the pipe will not be permitted.

W.7.2 Pipe Jointing:

Sections of pipe shall be tightly fitted together, and care shall be exercised to secure true alignment and grade. Before laying each joint of pipe the bell and spigot rings shall be thoroughly cleaned by wire brushing and wiping until clean and dry. Where pipe is being laid the gasket shall be placed on the spigot ring, and the spigot end of the pipe shall then be entered into the bell of the adjoining pipe and forced into position. The gasket and the inside surface of the bell shall be lubricated with a suitable solution (flax soap) which will facilitate the telescoping of the joint. The inside joint recess between ends of the pipe sections shall have a maximum and minimum width of one inch (1") and one-quarter inch (1/4") respectively. No "blocking up" of pipe or joints will be permitted.

The exterior joint shall be made by placing a cloth joint wrapper around the pipe which will be held in place with two (2) strands of wire. The cloth wrapper shall be seven inches (7") wide and hemmed on each side so that the wire "ties" may be inserted to hold the wrapper in place. The cloth shall be of such length that it will encircle the pipe, leaving enough opening between the ends to allow the mortar to be poured inside the wrapper. The wire ties shall be sixteen (16) gauge black annealed wire, or approved other, and shall be of such length as to encircle the pipe and overlap at the ends about eight inches (8") for tying. The wrapper shall be securely fastened before the joint is poured. The wire wrapper shall be similar and equal to the wrappers (diapers) as made by the Mar-Mac Manufacturing Company. The grout used for pouring the joint shall consist of one (1) part Portland Cement (Type 1) to two (2) parts of clean, fine, sharp platter sand and mixed to the consistency of thick cream. The joint shall be filled with this grout from one side in one (1) continuous operation until the grout has flowed entirely around the pipe. During the filling of the joint it shall be rodded with flexible wire to settle the grout.

Upon completion of backfilling of the pipe trench the inside joint recess shall be filled with a Portland cement mortar consisting of one (1) part cement to two (2) parts sand. After the joint has been filled the surface of the joint shall be leveled with the interior surface of the pipe, and the face of joint brushed with a wet brush.

Careful inspection shall be made of each joint to insure a smooth continuous interior surface. The interior of the pipe shall be thoroughly cleaned and any obstructions that may reduce its carrying capacity removed. Following completion of the pipe line progressively or in sections including completion of inside joints and inspections, insofar as might be possible or practicable, the line shall be kept filled with water.

It is required that a factory trained, qualified, job trained inspector is to be placed on the job. No pipe shall be laid unless such inspector is present and inspects the laying of the pipe.

Whenever necessary to patch any inside surface cuts on the inside surface of the pipe and where necessary to patch any clipped areas at the ends of pipe, such patches shall be made with a mortar of one (1) part Embeco (as manufactured by the Master-Builders Company), one (1) part Portland cement, and one (1) part clean, sharp sand, all measurements to be by weight. Pipe thus patched shall not be installed until the patch has been properly and adequately cured and unless approved for laying by the pipe manufacturer's inspector and by the Engineer.

W.8 REINFORCED CONCRETE WATER PIPE STEEL CYLINDER TYPE PRE-TENSIONED REINFORCEMENT (Steel Cylinder Type):

Concrete cylinder pipe, modified pre-stressed (or pre-tensioned reinforcement) when required as shown on the plans shall consist of a welded sheet steel cylinder lined with a dense concrete lining and around which there is placed reinforcing bars wound helically under measured tension, with a dense concrete coating covering the cylinder and the bars, and with steel joint rings of the bell and spigot type for rubber gasket. Pipe shall be in approximately thirty-two foot (32')

nominal lengths except for shorter lengths as required by special conditions. The pipe and pipe fittings shall comply with AWWA C301 or AWWA C303. C301 pipe shall be designed in accordance with AWWA C304, C303 pipe shall be designed in accordance with AWWA Manual M9.

The pipe manufacturer shall have had a successful experience record in the design and manufacture of concrete cylinder pipe and shall have had a substantial footage of pipe of similar size and with the same joint as offered for this project in successful operation for at least five (5) years.

All pipe and fittings shall have the approval of the Underwriter's Laboratories, Inc.

All pipe shall be Class 150 (designed for a working pressure of 150 psi) unless otherwise noted on the plans or in the Special Provisions.

W.8.1 Steel Cylinders:

The steel cylinders shall be fabricated from hot-rolled carbon steel sheets or plates. Sheets shall conform to the requirements of the current ASTM standards referenced in AWWA C301 or C303 and a minimum yield point of 30,000 psi. Plates shall conform to the requirements of the current ASTM A283, ASTM A285 or ASTM A36.

W.8.2 Curing:

Before wrapping the cylinder with the rod wrap, the lining is to be steam cured for a minimum period of fifteen (15) hours, after spinning with a moist steam between 90°F. and 125°F. Steam shall be applied to the inside lining within approximately two (2) hours after spinning. In lieu of steam curing, the lining may be kept moist for a minimum period of fifty-four (54) hours. This shall be accomplished by tightly sealing the ends of the cylinder with a waterproof membrane to retain the moisture in the mortar. Curing shall be as detailed in AWWA C301 and AWWA C303.

W.8.3 Shop Drawings:

Upon the award of the contract, the Contractor shall furnish the Engineer shop drawings showing the pipe and fittings to be furnished and shall include a location profile and a tabulated layout schedule as required by the Engineer. Such drawings shall be subject to the approval of the Engineer and fabrication of pipe and fittings shall not be commenced until such drawings have been approved by the Engineer.

W.9 IRON PIPE INSTALLATION:

W.9.1 Jointing Push-on Pipe:

- A. Materials: All component parts are to be furnished with and included in the price bid for pipe. The materials consist of a circular rubber gasket of modified bulb shape in cross section.
- B. Procedure: Remove any foreign matter in the gasket seat of the socket, wipe gasket clean, flex gasket and place in socket with the large round end or bulb end entering first. Seat gasket evenly around inside of the socket with the groove fitted over the bead. Remove any bulges. Apply a thin film of lubricant furnished by the pipe manufacturer to the inside surface of the gasket. No lubricant other than that furnished with the pipe by the pipe manufacturer will be allowed to be used. Wipe plain end of pipe, to be entered; clean and place in approximate alignment with the bell of the pipe to which it is to be jointed. Apply a thin film of the lubricant to the outside of the plain end about one inch (1") back from the

end. Align the pipe and carefully enter the plain end into the socket until it just makes contact with the gasket. Complete joint assembly by forcing the plain end of the entering pipe past the gasket until it makes contact with the bottom of the socket. For pipe in sizes ten inches (10") and larger, a jack-type tool will be used to make up the joint and complete the assembly of the joint in forcing the plain end of the pipe past the gasket.

- C. Deflection of Joints: The maximum deflection at each joint will not exceed manufacturer's recommendation.

W.9.2 Jointing Mechanical Joint Pipe:

A. GENERAL

This type of pipe shall be jointed in full accordance with the manufacturer's recommendations and shall be done in a neat and workmanlike manner. Care shall be taken to prevent shearing the bolts.

B. PROCEDURE

1. After carefully cleaning both spigot and bell and after slipping the following ring and the gasket over the spigot end, the spigot shall be slipped into the bell.
2. If requested by the Engineer or his Inspector, a lubricant shall be applied to the spigot to assist in assembly.
3. The gasket shall be carefully seated by hand so as to be even in the bell at all points.
4. After drawing up the follower ring to uniform bearing against the gasket the bolts will be inserted and tightened by hand in pairs using bolts opposite each other.
5. The nuts are to be tightened amply to hold the required pressure. Extension wrenches or pipes over wrench handles will not be permitted. Ten-inch (10") ratchet wrenches with a tension setting control shall be used to tighten the nuts unless other types of wrenches are approved by the Engineer.
6. The finished joint shall be neat and uniform and shall be watertight.
7. All nuts and bolts for mechanical joint and flanged joints shall be stainless steel.

W.9.3 Making Flanged Joints:

The Contractor shall be responsible for the measurement of all connections. Flanged piping shall be erected in accordance with the controlling dimensions shown on the plans. Each piece of flanged pipe shall be thoroughly cleaned to remove dirt, rust, grease and other foreign matter. Flanged faces shall be thoroughly wire brushed to insure even bearing for gaskets and mating flanges. Gaskets for flanged joints shall be rubber, Neoprene or SBR, full-faced, one-eighth inch (1/8") thickness, "Cranite" or approved other. Gaskets shall be UL listed. Flange bolts shall be installed with bolts in one (1) direction.

Flange bolts shall be tightened, each in turn, at a uniform rate around the joint. All flange bolts shall be Stainless steel. Flanged piping shall be manufactured in accordance with AWWA Specification C115 (ANSI A21.15).

W.10 CONCRETE BACKING:

Concrete shall have a compressive strength of not less than 3000 psi shall be used as a cradle or backing. All materials including aggregates, cement, and water, as well as the mixing and placing of the concrete, shall be approved by the Engineer. Bends of twenty-two and one-half degrees (22-1/2°) and greater, plugs, and all tees, crosses, etc., shall be backed with concrete as a thrust backing. Backing shall be placed between solid ground and the fitting to be anchored; the area of bearing on pipe and on ground in each instance shall be that required by the Engineer.

W.11 POLYETHYLENE ENCASEMENT:

The encasement of piping with polyethylene film in tube or sheet form shall be provided on all ductile iron pipe, related fittings, and valves. This wrap shall be an 8 mil. thickness polytube. Seams and overlaps shall be wrapped and held in place by two inch (2") wide plastic backed adhesive tape, Polyken 900 or Scotchrap no. 50, or an approved equal, with approximate two foot (2') laps on the polytube. The wrap on the barrel of the pipe shall be loose enough to allow the film to shift with the soil. The wrap shall be installed without breaks, tears, or holes in the film.

The Polyethylene film shall be installed in accordance with the specifications and requirements of AWWA C105 (ANSI A21.5).

W.12 COVER OVER PIPE AND CLEARANCE FROM OTHER PIPES:

It is intended that all water lines shall have a minimum cover of forty-two inches (42") unless otherwise specified on the plans. Where the lines are located in improved street with curb and gutter, the cover of forty-two inches (42") will be measured from the top of the curb to the top of the water pipe. Where the water lines are located in unimproved streets without curb and gutter, the cover of forty-two inches (42") will be measured from the bottom of road ditch to the top of the pipe regardless of the cover over the pipe at other points in the street. Across natural ground the cover over the pipe shall be measured from natural ground to the top of pipe. If a profile is shown on the plans, the Contractor will be required to lay the line to conform to the grades shown. If it is necessary that a water line shall have over forty-two inches (42") of cover in order not to exceed the manufacturer's recommendations for deflection of the pipe, the Contractor shall excavate the ditch with no extra compensation. Regardless of the depth of ditch necessary, the Contractor shall, under no condition, exceed the manufacturer's recommendations for deflection of the pipe at joints. The Contractor will receive no extra compensation for extra depth necessary to cross existing utility lines.

Attention is called to the fact that concrete cylinder pipe must be laid on a grade to insure proper jointing of the pipe. The grades will be determined in such a manner so as to avoid excessive use of fittings and specials and to provide a uniform grade between low points and high points. No additional compensation will be paid for extra trench depth required, to meet these conditions. Any differences of opinions concerning the grades as set by the Engineer must be resolved by the Contractor prior to pipe laying.

W.12.1 Clearance From Other Pipes, Sanitary Precautions and Disinfection, Interconnections, Backflow and Siphonage:

Water mains, pipes, etc., shall be designed and constructed to comply with the Texas Commission on Environmental Quality (TCEQ) Chapter 290 (Rules and Regulations for Public Water Systems). These rules and regulations are divided into several parts among which include the following requirements.

- A. When new water mains and new sanitary sewers are installed, they shall be installed no closer to each other than nine feet (9'). Where this cannot be achieved, the sanitary sewer shall be constructed of pressure type pipe with watertight joints as used in water main construction for the nine foot (9') clearance. Unless sewer manholes are made watertight, the edge of the manhole shall be located at least nine feet (9') from the water lines. The following table shall be used in determining minimum separation distances of various cases.
- B. When new water mains are installed where existing sanitary sewers are located, and when the requirements outlined in W.12.1(A) cannot be met because of physical conditions, extra precautions shall be taken by centering the water mains so that the pipe joints are at a maximum distance from the sewer line, by encasing the sewer line with concrete, and by installing the water main above the sewer line whenever possible.
- C. No physical connection shall be made between a drinking water supply, public or private, and the sewer or any appurtenance. Any facilities for permitting discharge of drinking water into the sewer or any appurtenance thereof shall be constructed so as to prevent any possibility of sewage entering the drinking water system.

TABLE - SEPARATION OF WATER AND SEWER LINES

<u>Condition</u>	<u>Location</u>	<u>MATERIAL</u>		<u>MINIMUM SEPARATION</u>		<u>Comments</u>
		<u>Water</u>	<u>Sewer</u>	<u>Vertical</u>	<u>Horizontal</u>	
NEW WATER AND NEW SEWER SYSTEM						
Sewer force main and gravity sanitary sewer parallel to water main	Water above Sewer	Std	CI DI PVC 150 psi	2 feet	4 feet	Separate trenches
Gravity sanitary sewer crossing water main	Water above Sewer OR Sewer above Water	Std	CI DI PVC 150 psi	6 inches	N/A	Center one joint of sewer pipe on water main. Cement stabilize sand backfill 12 feet past joints.
Gravity sewer crossing water main	Water above Sewer	Std	ABS, Clay Concrete Composite	2 feet	N/A	Cement stabilize sand backfill initial backfill zone of sewer for 9 feet each side of crossing. Center one joint of sewer pipe on water main.
NEW WATER AND EXISTING SANITARY SEWER						
New water parallel existing sewer	Water above Sewer	Std	ABS, Clay, Concrete CI DI PVC	2 feet	4 feet	If sewer shows no sign of leakage, then leave sewer alone. If sewer shows signs of leakage, then repair or replace.
New water crossing existing sewer	Water above Sewer	Std	ABS, Clay, Concrete Composite	2 feet	N/A	If sewer shows no sign of leakage, then leave sewer alone. If sewer shows signs of leakage, then repair or replace.
New water crossing existing sewer	Water above Sewer	Std	ABS, Clay, Concrete Composite	2 feet	N/A	Replace existing sewer with one joint CI, DI, PVC 150 psi, centering over water line.
New water parallel to existing sewer	Water above Sewer	Std	ABS, Clay, Concrete Composite	2 feet	4 feet	Replace exist. sewer with CI, DI, PVC 150 psi, or cement stabilized sand backfill in initial backfill zone of sewer where parallel closer than 9 feet, or encase the water in 150 psi pipe two nominal sizes larger.

TABLE - SEPARATION OF WATER AND SEWER LINES (continued)

<u>Condition</u>	<u>Location</u>	<u>MATERIAL</u>		<u>MINIMUM SEPARATION</u>		<u>Comments</u>
		<u>Water</u>	<u>Sewer</u>	<u>Vertical</u>	<u>Horizontal</u>	
EXISTING WATER AND NEW SANITARY SEWER						
New sewer parallel to existing water	Water above Sewer OR Sewer above Water	Std	CI DI PVC 150 psi	2 feet	4 feet	Separate trenches
New sewer crossing existing water	Water above Sewer OR Sewer above Water	Std	CI DI PVC 150 psi	6 inches	N/A	Center one joint of sewer pipe in water line.
New sewer crossing existing water	Water above Sewer	Std	ABS, Clay, Concrete Composite	2 feet	N/A	Cement stabilized sand backfill initial zone of sewer for 9 feet each side of crossing. Center one joint of sewer pipe on water main.

- D. No sewer lines carrying domestic or industrial wastes shall cross suction mains to pumping equipment. Water lines shall not be installed closer than ten feet (10') to septic tank drain fields.
- E. Sanitary precautions, flushing, disinfection procedures and bacteriological sampling, as prescribed in AWWA Standards and these specifications for disinfecting water mains, shall be followed in laying water lines.
- F. Pipe shall not be laid in water or placed where it can be flooded with water or sewage during its storage or installation.
- G. Where water mains are laid under any flowing stream or semi-permanent body of water, such as marsh, bay or estuary, the water main shall be installed in a separate watertight pipe encasement or double valves shall be provided in the line on each side of the crossing with facilities to allow the underwater portion of the system to be isolated and tested to determine that there are no leaks in the line under water. All lines four inches (4") and smaller should be encased.
- H. New mains shall be thoroughly disinfected in accordance with AWWA Standards and these specifications and then flushed before being placed in service. Samples shall be collected for bacteriological analysis to check the efficiency of the disinfection procedure, which shall be repeated if contamination persists.
- I. No physical connection between the distribution system of a public drinking water supply and that of any other water supply shall be permitted unless such other water is of a safe, sanitary quality and the interconnection is approved by the Texas Department of Health Resources.

- J. No water connection from any public drinking water supply shall be made to any sprinkling, condensing, cooling, plumbing or any other system unless the said connection is of such a design as will insure against any backflow or siphonage of sewage or contaminated water supply.
- K. The use of check valves, double check valves or backflow preventer is not considered as sufficient protection in separating potable and questionable water systems.

W.13 CONNECTION TO EXISTING WATER MAINS:

Where indicated on the plans and/or hereinafter specified, the Contractor shall connect the new main with existing mains or lines. The Contractor shall furnish all labor, materials, equipment, and services required for the locating and uncovering of the existing line, the making of cuts in the existing line, the removal, relocation, and connecting of the existing line into the new main and any and all appurtenant work required for a complete connection. Relocated mains or lines shall be laid so that all valves so relocated or installed shall be set vertically. Only such connections to existing mains as are necessary to load, test, and sterilize mains under construction with water from Owner mains will be permitted prior to the sterilization of new mains. All other connections to existing mains from a new main being constructed shall be made only after the new main has been adequately and satisfactorily sterilized and the Engineer or his Inspector has authorized the connections to be made. Contractors will be required to plug and block lines, crosses, tees, or other fittings installed in the new main to permit testing and sterilization prior to the making of connections. Such plugs and blocking shall be adequate to withstand a working pressure of 200 psi.

Connections to an existing line shall be made with full body ductile iron tapping sleeve and valve. Tapping sleeves shall be Mueller Model #H-615, American Flow Control Model #'s 2800/1004 or U.S. Pipe Model #T-9. With prior approval by the City Engineer, stainless steel Smith Blair 623 may be allowed for connection to existing lines twenty-inch (20") or larger. Approved valves are provided in Section W.14.1 of these specifications.

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

Connections to existing water mains shall be made at the locations shown, as specified, and/or as directed by the Engineer. All such connections shall be made in a most expeditious and workmanlike manner to cause the least inconvenience to water customers and to traffic and shall be made at night unless otherwise approved by the Engineer. The detailed schedule of operations for making each connection shall be approved by the Engineer or his Inspector before any work thereupon is commenced.

W.13.1 Pipe Handling:

Proper implements, tools, and facilities shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, fittings, and valves shall be carefully lowered into the trench piece by piece by means of derrick ropes or other suitable tools or equipment in such a manner as to prevent damage to pipe or pipe coating. Under no circumstances shall pipe or accessories be dropped into the trench.

At all times when pipe laying is not in progress, the open ends of the pipe shall be closed by approved means. No trench water shall be permitted to enter the pipe. All foreign matter or dirt

shall be removed from the pipe, and it shall be kept clean by approved means during and after laying. No pipe shall be laid in water or when trench conditions are unsuitable for such work.

Cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat workmanlike manner without damage to the pipe. Concrete pressure pipe shall not be cut on the job without the approval of the Engineer.

W.14 VALVES:

W.14.1 Gate Valves:

In general, all gate valves shall conform to the Standard Specifications for Gate Valves for Ordinary Water Works Service, AWWA C-509, except for changes or additions specifically outlined as follows:

Gate valves two-inch (2") to twelve-inch (12"), inclusive, shall be nut or handwheel operated, as shown on the plans. Valves, excluding tapping sleeve and valves, larger than twelve inches (12") may be Butterfly Valves.

Valves shall have flanged or mechanical joint ends. Bell and spigot pipe will use valves with Class "D" bells conforming to the Standard Specifications for Cast Iron Pressure Fittings, AWWA C-100, or a mechanical joint casting conforming to American National Standard Specifications for a mechanical joint for Cast Iron Pressure Pipe and Fittings, ANSI A21.11 (AWWA C-111). Flanged pipe will use valves with flanged ends conforming to ANSI B 16.11 Class 125).

All gate valves shall be epoxy coated body with resilient wedge. Valves must embody the best workmanship and finish, and open and close freely and easily. In closing, the gates must move without friction to their position opposite their ports, both discs being then closed squarely against the seat rings. When valves are in full opened position, the discs shall be raised clear of the water and provide an opening equal to the full normal diameter of the valve.

Gate valves shall be tested at a hydrostatic pressure of 300 psi, and shall be guaranteed for 150 psi water working pressure. Any leakage at the pressures through any castings or between the bronze ring and the cast iron body shall cause the said casting or assembled fitting to be rejected. No plugging or patching to stop any leakage will be permitted.

All gate valves shall open by turning counter-clockwise.

All bronze metal used in the working parts of the valve, with the exception of the valve stem, shall have a tensile strength of 34,000 psi.

Gate valves of the internal wedging type shall have solid wedges made of high grade bronze, having a tensile strength of at least 50,000 psi, with wide bearing surfaces of sufficient thickness to guarantee no bending or denting under abnormal strain, and such bearing surfaces shall be ground to flat surfaces on each face. The wedges in valves twelve-inch (12") and over may be trimmed with a heavy bronze mounting.

Gate valve stems or spindles shall be of high-tensile strength manganese bronze, or other non-corrodible metals as specified in ASTM B 584 CDA 844.

A specimen cut from any portion of the stem or spindle and machined to dimensions as in Figure 3, 4, or 5, "Standard Methods of Tension Testing of Metallic Materials", pages 699 and 700, A.S.T.M. Standards 1946, Part 1-A Ferrous Metals, shall produce tensile properties not less than

those shown in Table II, under "Standard Specifications for Manganese Bronze Rods, Bars and Shapes", A.S.T.M. Designation B 138.

A thrust collar on the spindle shall be cast integral with the spindle. A spindle having a thrust collar fastened or upset by any mechanical means is not acceptable. (There shall be provided a stem collar bushing suitably machined, to permit repacking the valve when it is in full open position. The stuffing boxes and glands shall be bronze bushed).

The manufacturer shall be required to furnish the Owner with certified copies of the hydrostatic tests and physical test of all metals used in the manufacture of the valves. Detail prints shall be furnished on all valves.

Gate valves (including tapping sleeves and valves) shall be Mueller Model Series 2360, M&H Model Series 4067/7571 or American Flow Control Model Series 2500.

W.14.2 Butterfly Valves:

In general, all butterfly valves and actuators shall conform to AWWA Standard for Rubber-Seated Butterfly Valves, AWWA Standard C 504 except for changes or additions specifically outlined as follows:

Butterfly valves may be used for valves, excluding tapping sleeve and valves, larger than twelve inches (12"). Manholes shall be constructed if required by the City Engineer or his/her designee.

The valve body shall be short body, flanged and made of cast iron or ductile iron. Flange holes shall be drilled full size. Valve seats shall be natural rubber or Buna-N and polished stainless steel, Type 304 or 316, 90° seating angle only with a 360° uninterrupted seating surface.

Shafts shall be Type 304 or 316 stainless steel. Shaft seals shall be standard split-V packing or double O-ring seal cartridges. Discs shall be ductile iron, cast iron or fabricated steel. Operating nuts shall be ductile iron.

Valves shall have flanged or mechanical joint ends or any combination of these as may be specified.

- A. Mechanical joint ends shall conform to AWWA Standard C 111 (ANSI A21.11).
- B. Flanged ends shall conform to AWWA Standard C 110 (ANSI A21.10), Class 250 lb.
- C. Bolts and nuts for mechanical joints shall be high-strength, low-alloy corrosion-resistant steel conforming to ASTM A 325 (Type 3).
- D. No flanged by slip-on or slip-on by slip-on ends allowed.

Manual Valve Actuators shall conform to the latest revision of AWWA Standard C 504 and shall be sized for the maximum valve torque requirements based on the operating pressures and flow rates as specified. The valve actuator shall be designed to hold the valve in the any intermediate position between fully opened and fully closed without creeping and fluttering. Actuator shall be located at the right end of a horizontal shaft. The input shaft shall be vertical and upward. Actuators shall be totally enclosed worm gear type and traveling-nut type Limitorgue, Type HBC or approved other.

The valve shall close by turning the input shaft clockwise. All hand wheels shall turn clockwise to close the valve.

The manufacturer shall be required to furnish the Owner with certified copies of the hydrostatic tests and physical test of all metals used in the manufacture of the valves.

Detail prints shall be furnished on all valves.

Butterfly valves shall be Mueller Model Series 3211 or M&H Model Series 4500/1450.

W.14.3 Distribution System and Fire Hydrants Lead Valves:

All hydrants lead valves and distribution system valves through twelve inches (12") in size shall be full opening, from body, non-rising stem, resilient seated wedge type valves equal or exceed applicable AWWA Standards, C509.

They shall be so designed that a complete ZERO leakage shutdown may be effected with flow in either direction at pressures of up to 200 psi, which shall be the working water pressure rating of the valves.

When fully opened, valves shall have a smooth, unobstructed waterway. All internal ferrous metal surfaces shall have an approved epoxy coating to provide a corrosion resistant barrier between the base metal and the surroundings. The epoxy coating shall be applied holiday free to a thickness of not less than 4 mils, shall be nontoxic after application and impart no taste to water.

Valves shall have two (2) or more "O"-ring stem seals. The stem shall have the thrust collar and bearing surfaces isolated from the waterway and provided with continuous lubrication, or it shall be provided with non-corrosive thrust bearings above and/or below the thrust collar. They shall be capable of being repacked in the fully open position, under pressure as stipulated in paragraph 16.5, AWWA C500.

Valves shall have flanged or mechanical joint ends. Bell and spigot pipe will use valves with Class "D" bells conforming to the Standard Specifications for Cast Iron Pressure Fittings, AWWA C-100, or a mechanical joint casting conforming to American National Standard Specifications for a mechanical joint for Cast Iron Pressure Pipe and Fittings, ANSI A21.11 (AWWA C-111). Flanged pipe will use valves with flanged ends conforming to ANSI B 16.11 Class 125).

All valves shall open by turning left and shall have a two-inch (2") square nut or be hand wheel operated as shown on the plans.

Contractors or suppliers shall furnish a detailed drawing that lists applicable ASTM numbers of all components.

All valves shall have nitrile, Buna-S, or EPDM or Urethane rubber seating materials.

All valves shall have high strength NDZ Bronze stem.

All bonnet bolts and nuts, "O"-ring plate bolts and nuts shall be stainless steel.

All tapping sleeve bolts and mechanical joint bolts for valves shall be Cor-ten or approved other.

W.14.4 Air Release Valves, Air/Vacuum Valves:

Air release valves, when shown on the plans or required, shall be the float and lever type, as is manufactured by the GA Industries, Inc., or approved other, or the air/vacuum type as is

manufactured by the GA Industries, Inc., or approved other. The inlet ends will be screwed for two-inch (2") and smaller, and flanged for three inches (3") and larger. Valves shall be equipped with a regulated closure device to prevent the valve from being slammed shut.

W.14.5 Installation of Gate Valves:

All valves shall be installed as shown on the plans. For each gate valve the Contractor shall furnish and install a valve box pad.

Valve boxes shall be three (3) piece screw type cast iron of the extension type and shall be similar to Mueller No. H-10360 or an approved other. The three (3) pieces shall consist of the top section, bottom section and cover. Extensions shall be provided as required. For three-inch (3") and smaller valves Mueller No. H-10366 or approved other will be acceptable. For fourteen-inch (14") and sixteen-inch (16") valves Mueller No. H-10357 with No. 160 base or approved other shall be furnished and installed. For sixteen-inch (16") and larger valves, manholes may be required as specified on the plans.

Valves shall be carefully handled and lowered into position in such a manner as to prevent damage to any parts of the valve.

Valves shall be placed in such positions as indicated on the plans with the stem in a vertical position and securely held until all connections have been made.

Gate valves and pipe fittings shall be set and jointed to new pipe in the manner herein specified for cleaning, laying, and jointing pipe. Hub ended valves shall be jointed to pipe only with lead joints. Flanged and mechanical joint valves will be preferred where suitable. Cast iron valve boxes shall be firmly supported and maintained centered and plum over the wrench nut of the gate valve. The box cover shall be set flush with the surface of the ground or at such other level as may be directed.

Concrete blocks shall be constructed around the top of the valve box. The concrete block shall be six inches (6") thick, by twenty-four inches (24") square outside dimensions 3000 psi strength concrete. All settlement shall have occurred or be obtained prior to the placement of the concrete block. The top of the valve box shall be flush with the finished grade of the concrete block and the surrounding terrain.

All valves shall be marked with a saw on the curb or pavement with "V". The "V" shall point to the location of the valve as follows: If the valve is in the paving, the "V" shall be marked upright; if the valve is outside the paving, the "V" shall be marked upside down.

W.15 FIRE HYDRANTS:

Fire hydrants, when required and when shown on the plans, shall conform strictly to AWWA Specifications C-502, Fire Hydrants for Ordinary Water Works Service, with the following supplementary details and changes or additions.

- A. Fire hydrants shall meet the requirements of the Texas Fire Insurance Division of the State Board of Insurance Commissioners.
- B. Type of shut-off may be compression type with the flow.
- C. Unless otherwise ordered inlet connection shall be six-inch (6") standard mechanical Joint hub, complete with all joint accessories. Inlet valve shall have not less than a five and one-

quarter inch (5-1/4") opening. Hydrant barrel I.D. shall not be less than seven and one-quarter inches (7-1/4").

- D. All hydrants shall be equipped with two (2) hose nozzles and one (1) steamer nozzle. The hose nozzles shall be two and one-half inches (2-1/2") nominal I.D. National Standard Thread. Pumper nozzle shall be four inches (4-1/2") nominal I.D. National Standard Thread. All nozzles shall be mechanically attached with a Storz unit which includes a cap.
- E. Unless otherwise approved, hydrants shall be furnished for a five-foot (5') depth of bury.
- F. One extension up to a four-foot (4') extension shall be permitted. Anything requiring more than a four-foot (4') extension will require a special order fire hydrant.
- G. Concrete pad twenty-four inch (24") square shall be poured around all fire hydrants. Concrete shall be 3000 psi, six-inch (6") thick with four (4) #3 bars.
- H. Positive operating drain valve or valves shall be provided to drain the hydrant properly. The seat of the drain valve shall be bronze (or other corrosion-resistant material), fastened securely to the hydrant. Stem threads shall be sealed away from water.
- I. All fire hydrants shall open by turning to the left (counter-clockwise).
- J. All fire hydrants shall be painted with two (2) coats of Tnemec Series 43-38H Diffused Aluminum, Silver Paint over one (1) shop coat of red lead paint.
- K. When a color code other than aluminum is required the top bonnet, including the lip and all nozzle caps shall be painted the appropriate color. Water Main Size: 6" - Tnemec Series 2H Hi-Build Tneme-Gloss, Chilean Red; 8" - Tnemec Series 2H Hi-Build Tneme-Gloss, True Blue Safety and for 12" & larger mains - Tnemec Series 2H Hi-Build Tneme-Gloss, Safety Yellow.
- L. Hydrants shall be of the breakable type, designed to break approximately three inches (3"), but not over five inches (5") above the ground line. These parts shall be of the breakable flange type, or breakaway lug. Breakable flanges screwed to the standpipe are not acceptable. Flanges shall be so designed that an end wrench can be used on the nuts and bolts. Provision shall be made in the design of the stem to disconnect the stem from the hydrant parts above the standpipe break-point in the event of a traffic accident. If breakable or sleeve type couplings are used, they shall have sufficient torsional strength such that a torsional failure of the stem will occur at some point other than at the coupling. Design of the coupling shall be such that when the coupling is broken no parts will come loose and fall into the hydrant, and the break will not occur through the pins or bolts holding the coupling to the stem.
- M. All hydrants shall be capable of being extended to accommodate future grade changes.
- N. Main valve seats on compression type hydrants closing with the flow shall be of such design that incorrect positioning is impossible and that the threads will be adequately guided into position. Arrangements shall also be made to hold the main valve gasket in place during assembly. Stainless steel bolts shall be furnished on the lower barrel to shoe connection.
- O. Gaskets furnished for ground line flanges shall be full face or shall be recessed to hold the gasket in place.
- P. "O"-rings may be furnished in lieu of packing. They shall be the double "O"-ring type, designed so that the rubber rings move against a bronze surface. All hydrants must have

travel stop device. Those using stem nut must be capable of being removed without any special tools. Any packing gland nut must be bronze.

- Q. Hydrants must be so constructed that the nozzle may be faced in any direction and located eighteen inches (18") from ground line.
- R. Each hydrant must have a sealed oil reservoir to provide positive lubrication of stem threads and bearing surfaces each time the hydrant is operated or shall be provided with a lifetime lubrication system contained in a grease chamber filled with an all temperature (-50°F to +125°F) grease. Addition of lubricant shall be through either an allen screw, a grease fitting or a flat head screw. Parts removal will not be acceptable.
- S. All hydrants must be equipped with a weather cap to prevent water from entering the bonnet.
- T. Each hydrant shall have a 4 mil epoxy coating on the interior of the shoe.
- U. Fire Hydrants shall be Kennedy K81-D or American Flow Control (Waterous) Traffic Model #WB-67-250. Iron or steel stems shall have bronze or stainless steel metal sleeve where passing through stuffing box or "O"-rings. Operating threads must be sealed against contact with the water at all times regardless of open or closed position of the main valve.
- V. The hydrants shall close with the pressure and shall have either a bronze cap not to seal the bottom end of stem threads against contact with water, or the stem shall not penetrate the lower valve plate.
- W. A Blue Stimsonite, Fire-Lite reflector model 88-SSA (or approved other) shall be placed just off center of the street or fire lane opposite fire hydrants. At intersections, reflectors shall be placed on both roadways opposite fire hydrant.

W.15.1 Fire Hydrant Installation:

Fire hydrants shall be located as shown on the plans or as directed by the Engineer and shall be set truly vertical with the base resting upon a 3000 psi concrete slab six inches (6") thick with four (4) #3 bars and approximately twenty-four inches (24") square. Pipe joints shall be made as specified for pipe laying. The hydrants shall be carefully and substantially blocked against firm trench walls with sound stone, sound slabs of or 3000 psi concrete, but no additional pay will be allowed for same.

W.16 SERVICE CONNECTIONS:

Water service connections shall be made by tapping the mains at specific points as designated by the Engineer. Service taps shall be made after the mains have been laid. The work shall be done by experienced workmen with suitable tapping machine and tools. A tapping saddle shall be used to connect service lines to pipe mains. To give ample space for expansion, the copper service pipe shall be connected to the corporation cock at the main and laid in the trench so that the service pipe will weave from one side of the trench to the other side of the trench and back in a distance of ten feet (10'). The service pipe shall be placed at a minimum depth of twenty-four inches (24") under the finished grade except where the service pipe shall pass under the curb. At this point the service pipe shall be a minimum of twenty-four inches (24") under the top of the curb or a minimum of six inches (6") under the bottom of the curb and gutter section, or lime stabilized subgrade whichever is greater. Excessive bending of the pipe, which will injure or reduce the cross sectional area of the pipe, will not be permitted.

The length of the service line shall extend from the main to a point two feet (2') back of the street curb at a depth of twelve inches (12") where curb exists or to the property line if no curb exists, unless shown otherwise on plans. Line shall be continuous with no fittings under paving. If there is a curb, the curb shall be sawcut with "I" in good quality blue paint at the point where the service pipe passes the curb. All water line services shall be located 2 feet from property lines. All services shall be 1" or larger as shown on the engineering drawings.

The subdivision plans shall be revised to indicate water service location as installed and shall indicate field measurement on ties to at least one (1) property corner.

W.16.1 Service Materials:

The service pipe shall be minimum one inch (1") or larger as shown on the engineering drawings for all residential properties and located two feet off the property line. Poly pipe, and shall conform to A.S.T.M. D2737 working pressure of 200 psi at 23 C, SDR 9, AWWA C901. Service materials shall be as shown in the following table:

TABLE - SERVICE MATERIALS

Part	Size	Manufacturer/Model #		
		Ford	Cambridge	A.Y. McDonald
CC PLUG (AWWA TAPER X COMP)	3/4"	F1000-3	302-A3H3	4701T/4701-22
	1"	F1000-4	302-A4H4	4701T/4701-22
	1-1/2"	N/A	N/A	4701T/4701-22
	2"	N/A	N/A	4701T/4701-22
CC BALL (AWWA TAPER X COMP)	3/4"	FB1000-3	301-A3H3	4701BT/4701B-22
	1"	FB1000-4	301-A4H4	4701BT/4701B-22
	1-1/2"	FB1000-6	301-A6H6	4701BT/4701B-22
	2"	FB1000-7	301-A7H7	4701BT/4701B-22
ANGLE VALVE (COMP X METER TAIL OR FL)	3/4"	BA43-333W	210-H3T3	4602BT/4602B-22
	1"	BA43-444W	210-H4T4	4602BT/4602B-22
	1-1/2"	FV43-666W	N/A	4602BT/4602B-22
	2"	FV43-777W	N/A	4602BT/4602B-22
CC TAP. SAD.	4-12"	202B (4-30")	N/A	3825

Sand embedment shall be used around the pipe, gravel shall be used around the corporation stop with minimum 3 inches under the meter.

Water meter boxes shall be furnished and set on each service. One-inch (1") water meter boxes shall be DFW Plastics Model # DFW-16 AMR with a 1600 AMR Bloc solid lid or approved equal. One and a half-inch (1½") and two-inch (2") meter boxes shall be DFW Plastics Model # DFW-65C Black or approved other. All meter boxes shall have AMR slide mount molded or screwed in to the lid.

All domestic water meters greater than two-inch (2"), shall be installed in a vault as per Standard Construction Detail W15.

W.17 CLEAN-UP:

During construction the Contractor shall maintain the premises in an orderly, neat, and presentable manner. Scraps and debris shall not be left scattered but shall be assembled together and such as are unusable shall be moved from the premises or disposed of to the satisfaction of the Engineer.

The Contractor shall make a final cleanup of all parts of the work before final acceptance by the Owner. This cleanup shall include among other things, left over construction materials, equipment, scraps, removal of all objectionable rocks, pieces of concrete, and other debris. Earthwork shall be smoothed and graded to the lines shown on the plans. Backfill over all trenches shall be left in a uniform and neat condition.

Disposal is not to be made on adjacent private or public property without written permission filed with the Engineer. If permission is granted by the property owners, the material so disposed of is to be leveled and left in a condition satisfactory to the Engineer.

W.18 STERILIZATION OF WATER MAINS:

During the construction operations workmen shall be required to use utmost care to see that parts of the structures, inside of pipes, fittings, jointing materials, valves, etc., the surface of which come in contact with Owner's water are maintained in a sanitary condition. Every effort must be made to keep the inside of the pipe, fittings, and valves free of all foreign matter, sticks, dirt, rocks, etc. As each joint of pipe is being laid it must be effectively swabbed so that all foreign matter is removed. All fittings and exposed open ends of pipe must be blocked or capped until the line is completed. Prior to any sterilization, pressure testing or flushing a Testing Program will be submitted to the Town showing total footage of pipe to be tested, locations of blow offs and designating sample locations to be used. Test locations will be clearly marked and numbered using half sized drawings of the proposed improvements.

The line shall be flushed out, completely replacing its entire volume with water from the Owner's mains. Once the line has been filled, all flushing is required to be metered, and paid for by the contractor at the current residential rate. Meters will be installed by the Town on blow offs as shown on the Testing Program. There will be a charge of \$25.00 for each 1" meter set and normal rates deposits will apply for moving fire hydrant meters.

- B. Chlorine will be injected into the section of line being sterilized so that its entire capacity will be filled with water containing chlorine in the amount of fifty (50) p.p.m. or in such other quantity as determined by the Engineer. The sterilizing agent shall be introduced at one end of the section and the water released from the opposite end until the sterilizing agent is present at the discharge end in such quantity as to indicate a residual-chlorine of fifty (50) p.p.m. or as otherwise determined by the Engineer. All valves shall then be closed and the sterilizing solution permitted to remain in the pipe line section for not less than twenty-four (24) hours.
- C. At the end of the sterilizing period the sterilizing solution shall be discharged from the pipe and replaced with water direct from a main of the Owner.

- D. A sample of water from the sterilized main shall be taken from a suitable tap under the supervision of the Engineer or his Inspector and submitted to a TCEQ approved testing laboratory. If the test shows a satisfactory quality of water, the line so sterilized shall then be placed in service by the Contractor who shall notify the Water Superintendent and assist the Water Superintendent in location and operation of all valves installed by the Contractor. If the sample shows unsatisfactory quality of water, the process of sterilization shall be repeated until satisfactory water is obtained. The lines shall be disinfected in accordance with AWWA C651, latest revision thereof.
- E. Sterilization of the line or any section thereof shall not be commenced until the Engineer's approval of the method, apparatus, sterilizing agent, and the section of the line has been obtained.
- G. Test samples will be done to meet the TECQ requirements and test stations will be the contractor's responsibility. When additional taps are required to meet sampling frequency the contractor shall submit his procedure for the Towns approval. Samples will be taken at 1,000 lf and with the Towns inspector present. Samples will be wrapped by the Town's Inspector with tamper proof tape prior to leaving the construction site.

W.19 INSPECTION AND TESTS:

Tests and inspection will be made on the entire project by sections designed by the Engineer to ascertain that the main is in an acceptable condition to perform the function for which it was designed and constructed.

The City will furnish the Inspector to observe the construction of the project on a routine basis. No final acceptance will be given until the entire project has been completed; including all tests conducted and passed as may be required.

W.19.1 Inspection – General:

During the process of unloading, all pipe and accessories shall be inspected by the Contractor for loss or damage in transit. No shipment shall be accepted by the Contractor until notation of any lost or damaged material shall have been placed on the bill of lading by the agent of the carrier.

All pipe and accessories shall be laid, jointed, tested for defects and for leakage with pressure, and chlorinated in the manner herein specified in the presence of the Engineer or his authorized Inspector and subject to their approval.

All material found during the progress of the work to have cracks, flaws, or other defects will be rejected by the Engineer, and the Contractor shall promptly remove from the site of the work such defective material.

The Contractor shall be responsible for all material furnished to him or by him and shall replace at his own expense all such material that is found to be defective in manufacturing or that has become damaged in handling after delivery by the manufacturer. The Contractor shall be responsible for the safe storage of material furnished by or to him until it has been incorporated in the completed project.

Pipe fittings, valves, and other accessories shall be unloaded at the point of delivery, hauled to, and distributed at the site of the project by the Contractor. They shall, at all times, be handled with care to avoid damage. In loading and unloading they shall be lifted by hoists, slid or rolled on skidways in such a manner as to avoid shock. Under no circumstances shall they be dropped. Pipe handled on skidways must not be skidded or rolled against pipe already on the ground.

In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Pipe shall be handled in such a manner that a minimum amount of damage to the coating will result. Damaged coating shall be replaced in a manner satisfactory to the Engineer.

Pipes shall be placed on the site of the work parallel with the trench alignment and with bell ends facing the direction on which the work will proceed unless otherwise directed. The interior of all pipe, fittings, and other accessories shall be kept free from dirt and foreign matter at all times.

W.19.2 Visual Inspection:

During the course of the construction, the Inspector will make continuous routine inspection to ascertain that the project is being constructed in accordance with the plans and specifications and that the materials are of the type and kinds specified.

Upon completion of the project, or part of the project, the Engineer, or his authorized representative (the Inspector) in the company and a representative of the Contractor (usually the job foreman) will make a visual inspection of all the project, or a part of the completed project, checking the following items:

- A. Verify that all ditches are properly backfilled and compacted to these specifications.
- B. Verify that all lines are loaded and pressurized from the Owner's system. Blow all fire hydrants and test coppers to bleed off air and to flush out lines. Large leaks should show at this stage.
- C. Check all valves for location of vertical stacks on valve stems and uncover if found buried to verify if the valves are operable and to determine whether they are open or closed and that they cannot circulate into lines that are in service. No bells are allowed on the vertical stacks. Old valves being replaced must be checked before use to ascertain that they do not leak more than the allowable, as established in AWWA C500.
- D. Locate and uncover all chlorination and test coppers.
- E. Verify that full pressure has been left on all lines after loading.
- F. Verify that all special structures, such as bored or tunnelled section, manhole or access to the encasement pipe, are properly constructed and ready for the hydrostatic test. On all flexible pipe check to verify that deflection does not exceed the allowable for the materials.
- G. When the above items have been checked, and corrections made, if any, the Inspector will notify that the hydrostatic test can be made and the Contractor shall proceed to make the test.

W.19.3 Hydrostatic Test:

Before being accepted, all ductile iron, and polyvinyl chloride pipe lines constructed under this contract shall be tested with a hydraulic test pressure of 200 psi, maintained over a period of three (3) hours. Concrete pressure pipe shall be tested with a hydraulic test pressure of one-hundred twenty percent (120%) of the design pressure. Please see W.18 for the testing program.

After the pipe has been laid and backfilled but prior to replacement of pavement each valved section of newly laid pipe shall be subjected to a hydrostatic pressure test. For any section being tested the pressure applied shall be such that at the lowest point in the section the pressure shall be a minimum 200 psi. Adjustment as required shall be made for differential in elevation between the low point of the section being tested and the centerline of the pressure test gauge.

Each valved section of pipe shall be slowly filled with water, and the specified test pressure, measured to the point of lowest elevation shall be supplied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, and all necessary apparatus including gauges and meters shall be furnished by the Contractor. The Owner will furnish water for filling lines once through existing mains. All water discharge for filling the line will be monitored by use of meters. The duration of each pressure test shall be three (3) hours.

Before applying the specified test pressure all air shall be expelled from the pipe. To accomplish this taps shall be made, if necessary, at the points of highest elevation and afterwards tightly plugged.

At intervals during the test the entire route of the pipe line shall be inspected to locate any leaks or breaks. Any defective joints, cracked or defective pipe, fittings, or valves discovered in consequence of this pressure test shall be removed and replaced with sound material in the manner provided, and the test shall be repeated until satisfactory results are obtained.

No pipe installation will be accepted until the leakage is less than a rate equal to twenty-five (25) gallons per inch of nominal diameter per mile of pipe over a twenty-four (24) hour period. Factors for leakage are shown on the following table:

TABLE – LOSS BASED ON 24 HOUR TEST AND 25 GALLON LIMIT

Pipe Diameter D (Inches)	<u>Loss Factor (Gallons)</u>
6	0.00355(L)
8	0.00473(L)
12	0.00710(L)
16	0.00947(L)
18	0.01065(L)
20	0.01184(L)
24	0.01420(L)
30	0.01776(L)
36	0.02131(L)
48	0.02841(L)

Should any test of pipe in place disclose leakage greater than that specified, the Contractor shall at his own expense locate and repair the defective joints until the leakage is within the specified allowance.

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

W.19.4 Compaction Test:

Frequency of tests shall not be less than one (1) for any pipe section and every three hundred linear feet (300') linear feet of main pipe per two feet (2') of lift until final grade, starting at two feet (2') above the top of pipe. Water services are to be tested at a rate of one (1) for every six (6) services which cross the proposed right of way or every three hundred linear feet (300') of water service installed. Every other fire hydrant lead that cross the existing or proposed street, alley, or firelane subgrade shall also receive at least one set of density tests. All ditches shall be mechanically tamped and compacted to ninety-five percent (95%) Standard Proctor Density at zero percent (0%) to four percent (4%) above optimum moisture. Water jetting is not permitted.

If there is any doubt in the opinion of the Engineer that the compaction requirements as stipulated have not been met, then the Engineer may order such Density Test made by a soils engineering firm at the expense of the Owner. If these tests prove that the backfill is not of sufficient compaction, then the Contractor will be required to remove the backfill and replace the backfill properly compacted to obtain the value required or re-compact to secure the compaction required. If a retest indicates that compaction is not satisfactory, the retest will be at the Contractor's expense.

W.20 MEASUREMENT AND PAYMENT:

The bid items include the work of every nature required for the completion of the job in every respect except as may be otherwise provided for in these specifications. The Contractor shall include the furnishing of all materials and labor, including any incidental labor, in his bid prices.

Trenching and Backfill:

- A. Trench excavation for water mains will not be paid for directly but will be included in the price bid per linear foot for the various sizes of water pipe.
- B. Unclassified excavation is not a pay item and will not be paid for directly but shall be included in such other items as are provided.
- C. Payment for all special excavation, if applicable, will be in addition to the price bid for pipe line in normal excavation and will be per linear foot of trench or special excavation.
- D. Sheathing left in place will be paid for by the cubic yard in place, per M.C.B.M.
- E. Backfilling will not be paid for directly but will be included in the unit price bid per linear foot for the various sizes of pipe. Fifteen percent (15%) of the price bid for water mains complete in place may be withheld for incomplete or unacceptable backfill.

- F. Gravel cushion, granular backfill, concrete cushion, and concrete encasement shall be paid for at the unit bid price per cubic yard in place in the fill, unless shown on the plans to be included in other items of construction on the project.
- G. Tunneling, boring, and/or jacking shall be paid for at the unit bid price per linear foot. Where casing is required to be placed by tunneling, boring or jacking, the casing and furnishing the casing complete in place and will be paid for at the unit bid price per linear foot.
- H. Casing of water pipe shall be paid for at the unit bid price linear foot in place if placed in open cut. If in tunnel or by boring or jacking see above.
- I. Concrete encasement measurement and payment will be made by the cubic yard in place.
- J. The minimum width of asphalt pavement replacement will be as follows for the size pipe shown as installed. All pavement replacement outside these limits will be at the Contractor's expense.

MINIMUM WIDTH FOR ASPHALT

<u>Pipe Diameter D (Inches)</u>	<u>Pavement Replacement (Inches)</u>
2	30
4	36
6	36
8	42
10	44
12	46
16 and above	Pipe O.D. + 30

Pipe: Pipe will be measured from center of fitting to center of fitting or end of pipe without any deduction for the length of intermediate fittings or valves. Payment will be made at the price bid per foot for furnishing and installing pipe, which bid price will include all costs for the complete pipe installation, including trenching and backfill, and shall include all work not otherwise provided for in these specifications.

Fittings: Payment for cast iron or ductile iron fittings will be at the unit price per ton bid for such work. This shall include the furnishing and installation of the fitting. This unit price shall also include the cost of concrete backing or blocking or restrained joints. Weight shall be determined from the manufacturer's catalogs. No separate payment will be made for galvanized pipe fittings. If mechanical joint fittings are used, payment will be based on weights of mechanical joint fittings and joint accessories.

Restrained Joints: No separate payment will be made for restrained joints or fittings, valves, etc. including required joints on straight pipe.

Concrete Backing: No separate payment will be made for concrete backing or blocking of fittings, valves, etc. The Contractor shall include such costs in the price bid for setting fittings, valves, etc.

Polyethylene Encasement: The cost of the polyethylene tube wrap and complete installation shall be included in the unit price bid for the furnishing and the installation of ductile iron pipe, related fittings, and valves.

Connections to Existing Mains: Payment for valves, fittings, pipe, etc., will be made at the unit price bid for the various items. No additional payment will be made for "DRY" connections, but a lump sum will be paid for each "WET" connection made as specified in these specifications.

Valves and Tapping Sleeves & Valve: Shall be paid for at the unit price bid for each. Price shall include the cost of the valve or tapping sleeve & valve, as well as the valve box and labor complete in place.

Fire Hydrants: Payment for the furnishing and installing of fire hydrants will be made at the unit price bid, complete in place.

Water Service: Water services will be paid for as a lump sum bid for each water service connection. The lump sum will include tapping the main, furnishing and installing the corporation stop, curb stop, meter box, and the copper service line necessary to meet the specifications. The lump sum bid shall also include all necessary labor and the marking of curb when a curb exists.

Sterilizing: No separate payment will be made for sterilizing the main. The cost of such work shall be included in the price bid for pipe in place.

Hydrostatic and Compaction Tests: No separate payment will be made for the tests. The cost of the tests shall be included in the bid price for pipe in place.