

DIVISION 9
WATER MAINS AND APPURTENANCES

9.01 WATER MAINS AND APPURTENANCES

9.01.01 Description of Work

The work to be done under this contract consists of construction of installation of ductile cast iron pipe water mains with appurtenances. Under certain circumstances the City of Midland will allow the installation of AWWA C909 Poly-Vinyl Chloride (PVC-C909) pressure pipe. The use of PVC must be approved by the City of Midland Water Distribution Department before project design. The Contractor shall furnish all of the labor, materials, equipment and tools to do all of the work required in excavating, hauling and laying of pipe and special castings, setting valves, valve boxes and hydrants; constructing valve chambers; backfilling all trenches, tunnels, and holes; reconstructing parts of pavements, curbs, sidewalks, ditches, outlaws, sewers, drains and other utilities removed or damaged during construction of the water main; removing and disposing of all surplus excavation. All such items of work are to be done in accordance with the plans and specifications.

Water main installation as part of any new development must include the installation of water services to each lot of development. Split services will not be allowed. The service(s) must be installed to City of Midland specifications. Services shall be installed with a "pigtail" from the curb stop to above grade before pressure testing so services can be flushed prior to and be a part of, the pressure testing process. Curb boxes shall be protected from damage during construction using a wooden stake painted blue as an identification marker. Contractors are not allowed to tap any existing City of Midland water main. Service(s) larger than 1" must be tapped through a stainless steel service saddle. Any repairs to services or water main necessary after pressure testing will be done by the City of Midland Water Dept. as time and material billed to the contractor or developer.

9.01.02 Materials

The Contractor shall furnish all water line materials including pipe, fittings, valves, hydrants, valve boxes, joint accessories and joint lubricant and tracer wire (if needed). All materials including pipe, fittings, valves, hydrants, valve boxes and joint accessories shall be manufactured in North America.

The Contractor shall furnish all miscellaneous materials such as concrete, reinforcing steel, and other necessary materials to the installation of the water main. The costs of all materials to be furnished by the Contractor are to be included in the Contract unit prices. Unless otherwise noted, materials shall meet the following requirements:

Pipe - Class 50 Ductile Iron Pipe in full accordance with A.S.A. A21.51 or AWWA C151, with ANSI/AWWA C104/A21.4 standard thickness cement mortar lining and push on joint. When permitted Polyvinyl Chloride (PVC) Pressure Pipe in full accordance with AWWA **C909**. PVC pipe must be stamped with "NSF - pw" or "ANSI/NSF 14 & 61" showing that it conforms to NSF 14 and 61 for potable water pipe.

HDPE Pipe

PE materials used for the manufacture of PE pipe shall be PE4710 high density polyethylene meeting ASTM D3350 cell classification 445574C. The material shall be listed and approved for potable water in accordance with NSF 61. Pipe shall be manufactured and marked to the requirements of ASTM F714 and AWWA C906.

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The outside diameter of the pipe shall be based on the Ductile Iron Pipe Size (DIPS) sizing system. Pipe shall be DR11 (pressure class 200 psi). Molded fittings shall be manufactured and tested in accordance with ASTM D 3261 and AWWA C906. Joints between plain end pipes and fittings shall be made by butt fusion. The Contractor shall ensure that persons making heat fusion joints have received training per the Manufacturer's recommended procedure, ASTM F2620 and PPI TR-33. Installation shall be in accordance with ASTM D2774, AWWA M55 and manufacturer's recommendations. Mechanical connection of HDPE to auxiliary equipment such as valves, pumps, and fittings shall use mechanical joint adapters. MJ Adapters 14" and above shall be provided with Heavy Duty Back-up Ring Kits. All MJ adapters 18" and above must be provided with Stainless Steel stiffeners.

Pipe (Horizontal Directional Drilling) - Polyvinyl Chloride (PVC) Pressure Pipe in full accordance with AWWA C900. PVC pipe must be stamped with "NSF - pw" or "ANSI/NSF 14 & 61" showing that it conforms to NSF 14 and 61 for potable water pipe. High Density Poly-Ethylene (HDPE) Pressure Pipe in full accordance with AWWA C906. HDPE pipe must be stamped with "NSF - pw" or "ANSI/NSF 14 & 61" showing that it conforms to NSF 14 and 61 for potable water pipe. These products are the only acceptable products for City of Midland HDD projects:

- THERMAL BUTT FUSED HDPE
- C900/C905 FUSIBLE PVC®
- C900/RJ™ CERTA-LOK® RESTRAINED JOINT PVC

Fittings - To be ductile iron, mechanical joint in accordance with ASA 21.10 or AWWA C110, with ANSI/AWWA C104/A21.4 standard thickness cement mortar lining suitable for use with class 50 Ductile Iron Pipe.

Gaskets – All Rubber Gasket Joints shall conform to AWWA C111/A21.11.

Restrained Joints – For ductile iron push joint pipe, FIELD LOK 350 Gaskets shall be used. For ductile iron mechanical joints, Series 1100 MEGALUGS shall be used. For PVC push joint pipe, Series 1900 Restraint Harnesses for C909 shall be used. For PVC at mechanical joints, Series 19MJ00 Restraints for MJ Fittings on C909 shall be used.

Fasteners – For all below grade ductile iron piping and components, fasteners shall be Cor-Blue T-Head Bolts and Nuts unless otherwise approved.

Mechanical Joint Valves - To be AWWA C515 standard for resilient seated gate valves. All valves shall open to the left, have a 2" square operating nut and be the NRS type O-ring stem seals as manufactured by American, Clow, Kennedy, EJ and Waterous.

Mechanical Joint Butterfly Valves - To be AWWA C504. All valves shall open to the left, have a 2" square operating nut, have corrosion resistant discs, Type 304 SS shaft full length through disc, Buna-N rubber seats with a minimum 30 turns from the open to closed position, suitable for direct burial and of the short body style, as manufactured by the Henry N. Pratt Company or equal.

Valve Boxes - To be 3 piece, Size "D", 5 1/4" shaft-screw type with lids marked

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"WATER", as manufactured by EJ, Bibby, Tyler Union or equal.

Fire Hydrants - Shall conform to AWWA C502, 6" flange pipe inlet or 6" MJ inlet, shall have 1" square operating nut (tapered) for opening left, minimum 5¼" valve openings, shall have two (2) - 2 1/2" hose nozzles (National Standard Thread) and one (1) - 4 1/2" pumper connection (National Standard Thread). Hydrants shall be outfitted with a 5" Storz Permanent Hydrant Adaptor (with Cap) attached to the 4 ½" pumper connection. Hydrants shall have the upper barrel painted red and the port caps painted white with heavy duty exterior enamel. All fire hydrants shall be non-drain traffic model variety. All hydrants shall be assembled with stainless steel bolts. For water mains located within the roadway, hydrant bury depth shall be 6'-0" unless noted otherwise on the project drawings. For water mains located within the outlawn, hydrant bury depth shall be 5'-6" unless noted otherwise on the project drawings.

In the interest of system uniformity, the hydrants shall be limited to one of the following types:

1. American AVK
2. American Darling – B84B
3. East Jordan - 5-BR or 5CD250
4. Mueller - Centurion

Tracer Wire – Shall have HDPE insulation designed and intended for direct bury.

- Open Trench – Trace wire shall be #12 AWG Copper Clad Steel, High Strength with minimum 450 lb. break load, with minimum 30 mil HDPE insulation thickness
- Directional Drilling/Boring – Trace wire shall be #12 AWG Copper Clad Steel, Extra High Strength with a minimum 1,150 lb. break load, with minimum 30 mil HDPE insulation thickness
- Pipe Bursting/Slip Lining – Trace wire shall be 7 x 7 Stranded Copper Clad Steel, Extreme Strength with 4,700 lb. break load, with minimum 50 ml HDPE insulation thickness
- Test Stations shall be light duty with a minimum of 14" bury capable of handling up to three terminals allowing above ground access with tracer equipment while tracer wire remains protected.
- Tracer wire shall be terminated in Valco TWAB access boxes, or approved equal.

Water Services Customer Side of Curb Stop– Services and Service Valves shall conform with AWWA C800.To be Type K copper or HDPE IDR-7 meeting AWWA C901 with min. 160 PSI. Fittings for services shall conform with AWWA C153/A21.53.

Water Services City Side of Curb Stop– Services and Service Valves shall conform with AWWA C800.To be Type K copper. Fittings for services shall conform with AWWA C153/A21.53.

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Service Saddles – Shall conform to ANSI/AWWA C230. Shall have bands made of stainless steel type 302 or 304 with an AWWA tap thread. Stainless steel bolts and nuts treated to resist galling. Bolt size shall be sufficient to withstand the forces when the saddle bolts are tightened to the recommended torque. Gasket material shall be 100% new rubber polymer compound or neoprene design for fresh water service. Finish on the Studs shall be stainless steel, smooth and free of burrs which would prevent proper fit of bolts, or would cause injury in handling. Clamp shall have minimum of two (2) studs as manufactured by Romac 306, Ford FS300, Smith Blair 372 or equal.

Corporations – Shall be one of the following:

Ford FB1000-NL
AY McDonald 74101B-22NL
Mueller B25008

Curb Stops – Shall be one of the following CTS Pack Joint x IDR-7 Pack Joint:

Ford B46-NL
AY McDonald 76100-22-33-NL

Curb Boxes – Boxes shall Buffalo Style, size 95E with a stainless steel extension rod and center piece. The lid shall have the word "WATER" cast neatly and legibly on it and shall be held securely in place by a bronze or brass bolt as manufactured by EJ, Bibby, Tyler Union or equal.

Meter Pit Setters – In the interest of system uniformity, Meter Pit Setters shall be limited to one of the following types. Any other Meter Pit Setter Styles must be submitted to Water Distribution for approval.

1" Meter Pit Setter –

Ford PDBB-488-20-48 - NL with W3-T double lid cover
Ford PFCBB-488-20-48-FP-R-NL with Ford PPSC-18-L-T Cover
Mueller – 330-CS-18-48-F-F-B-S-N with Mueller 282925 Cover
Mueller – 330-AS-18-4248-F-F-B-S-N with Mueller 282925 Cover

1-1/2" Meter Pit Setter –

Ford – PMBB-688-36-48-NL with MC-36-MB-T Cover
Mueller – 500-VS-36-48-F-F-B-N with Mueller 790438 & 282925 Cover

2" Meter Pit Setter –

Ford – PMBB-788-36-48-NL with MC-36-MB-T Cover
Mueller – 550-VS-36-48-F-F-B-N with Mueller 790438 & 282925 Cover

Sampling/Chlorinating Lines—Shall be Type K copper

Polyethylene Encasement – Polyethylene encasement shall conform to AWWA C105. Film shall be Class "C", black or blue with a nominal thickness of 8 mils, minimum tensile strength of 1200 PSI, elongation of 300%, and dielectric strength of 800 V/mil thickness. Tape for securing the film shall be a thermoplastic material with a pressure sensitive adhesive face capable of bonding to metal, bituminous coating and polyethylene. Tape shall have a minimum thickness of 8 mils and a minimum width of 1". Tape shall be Agri-Drain tile tape or equivalent.

Blow-off Assemblies – Fittings shall conform to AWWA C800 consisting of 2" Type K copper. Temporary blow-offs shall be a minimum 2' above grade with a 90° male iron pipe thread fitting. Permanent blow-offs shall be 2" male iron pipe thread straight coupling set in a Ford Double Lid Cover meter box with standard size pentagon bolt

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(W3-T) or equivalent and installed flush with a lawn or cement surface. All fittings shall conform with AWWA C153/A21.53. All blow-off assemblies shall become property of the City of Midland Water Department.

Water Main pipe, fittings, valves, hydrants, and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such material be dropped. Pipe handled on skid ways shall not be skidded or rolled against pipe already on the ground. In distributing the material at the site of work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Pipe shall be handled so that the coating and lining will not be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by the Contractor at his expense in a manner satisfactory to the Engineer.

9.01.03 Excavation

The excavation for the water main shall be done in open trench or in tunnel as herein specified, as shown on plans. All work shall be done to true line and grade as established on the plans, and the line and grade stakes set by the Engineer. The Contractor must protect the line and grade stakes and be held responsible for any defective work occasioned by his negligence in this regard. The Contractor shall remove all rubbish and encumbrances which may be in the proposed line of the water main and the cost for doing said work shall be understood as being included in the contract unit price per lineal foot, for laying water main.

A trench width of not less than 20 inches or more than 26 inches shall be excavated for laying six inch, eight inch, ten inch, or twelve inch pipe. For larger sizes of pipe the trench width shall be not less than one and one-half times the diameter of the pipe to be laid. Bell holes shall be excavated at each joint.

Rock or stones found in the bottom of the trench shall be removed for a depth of at least six inches below the bottom of the pipe and the holes thus created and all other irregularities in the trench bottom shall be filled to grade with Class II sand before the pipe is laid and the cost of doing such work is understood as being included in the contract unit price per lineal foot for constructing water main.

All new water main piping shall be placed on 4 inches of Class II sand bedding.

All sheeting and bracing necessary, in tunneling or for supporting the sides of the trench and shafts, shall be furnished by the Contractor. Said sheeting and bracing shall be removed by him as the work progresses, and the space occupied by the sheeting filled solid with earth, sand or concrete as directed by the Engineer. When ordered in writing by the Engineer, that sheeting is to remain in place, it shall be estimated and paid for as an extra at the price agreed upon.

The Contractor shall at his own expense pump out or otherwise remove any water which may gather in the trenches or tunnels, and shall form all dams, cofferdams or other works necessary for keeping the excavated trenches or tunnels clear of water during the progress of the work. In case of quicksand or other bad and treacherous ground the work shall proceed day and night without intermission, if the Engineer so directs.

In excavating for open trench in parks, parkways and lawns. If suitable sod is in place, the Contractor shall remove and store to be replaced over and along the trench work, to a proper condition. Otherwise four inches of topsoil loam shall be placed over excavation.

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Whenever the water main crosses the street, permanent sidewalks, crosswalks, or pavements, work shall be performed in tunnel, unless otherwise stated on plans, without disturbing the surface or structure. Whenever it becomes necessary to remove sidewalks, cross-walks, approaches, curb and gutters, sewer basins, sewer connections or any fixed or permanent improvements shown on the plans, the Contractor shall be required to replace same with new materials to the satisfaction and acceptance of the Engineer; and the cost of doing said work shall be understood as being included in the contract unit price per lineal foot, for laying water main.

When and where portions of the pavement have been disturbed or removed by the Contractor as required under these specifications, the Contractor shall relay the same in accordance with standard specifications for Street Improvement of the City of Midland.

Whenever obstructions not shown on the plans are encountered during the progress of the work and interfere to such an extent that an alteration in the plans is required, the Engineer shall have the authority to change the plans and order a deviation from the line and grade or arrange with the owners of the Structures for the removal, relocation or reconstruction of the obstructions. If the change in plans result in a change in the amount of work by the Contractor, such altered work shall be done on the basis of payment to the Contractor for extra work or credit to the City for less work.

The Contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures, both known and unknown, may be determined, and he shall be held responsible for the repair of such structures when broken or otherwise damaged because of carelessness on his part.

Whenever, in the opinion of the Engineer, it is necessary to explore and excavate to determine the location of existing underground structures, the Contractor shall make explorations and excavations for such purposes. If the Contractor is required to perform additional work in making the explorations and excavations, extra compensation will be allowed for such additional work.

9.01.04 Turning On or Off Valves and Hydrants

No valve or other control on the existing system shall be operated for any purpose by the Contractor. The city will operate all valves, hydrants, and curb stops.

9.01.05 Laying Pipe

Installation of pipe and appurtenances shall be completed in conformance to AWWA C600, latest version (for Ductile Iron pipe) or AWWA C605, latest version (for PVC pipe). After the trench or tunnel has been excavated and the bottom has been graded and prepared, the pipe shall be carefully laid making sure that at least two thirds of the length of the body of the pipe is resting firmly on the prepared grade. Blocking under the pipe shall not be permitted. The interior of all pipe and special castings must be thoroughly cleaned by brushing, swabbing or washing out all dirt before lying. Pipe shall be laid with bell ends facing in the direction of lying. The inside of the bell and the outside of the spigot end shall be cleaned of foreign matter.

A thin film of gasket lubricant shall be applied to the spigot end of the pipe. Gasket lubricant shall be supplied by the pipe manufacturer or approved by the Engineer. All branches or other openings shall be stopped up with wooden plugs or heads until either capped or connected. The Contractor shall take every effort to prevent ground water or other forms of contamination from entering the pipe.

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At a minimum, restrained joints shall be installed as per the project plans and pipe manufacturer's recommendations.

Polyethylene wrap shall be provided and installed as part of the water main installation. The wrap shall be 8 mil thick Class "C" (black or Blue) polyethylene conforming to AWWA standard specification for Polyethylene Encasement for Ductile Iron Pipe, AWWA

C105/A21.5. The wrap shall overlap the joint by 12" to both sides and be secured to the pipe with polyethylene adhesive tape. **AT NO TIME WILL INSTALLED PIPE BE ALLOWED TO REMAIN IN CONTACT WITH SOIL. ALL RIPS, TEARS OR DAMAGED AREAS OF THE POLYBAG SHALL BE REPAIRED WITH TILE TAPE TO COVER EXPOSED AREA.** All piping and fittings shall be wrapped and taped.

The purpose of the polyethylene wrap is to isolate the pipe from contact with corrosive environments and no attempt is made for complete sealing to prevent ground water intrusion. The standard backfilling procedure specified in 9.01.15 will provide adequate protection for the polyethylene wrap. The cost for the wrap shall be considered incidental to the unit price bid per lineal foot of water main.

The contractor shall install tracer wire on all pipe installations, both metallic and non-metallic. The tracer wire shall be attached to the top of the water main. The tracer wire shall be continuous between access boxes. Splices are not permitted. Access boxes shall be brought to grade and located behind fire hydrants. Minimum spacing between access boxes shall be 300'. Maximum spacing between access boxes shall be 1,000'. The wires shall be attached to stainless steel screws mounted to the underside of the lid, with a minimum 2' of slack. A continuity test shall be performed and shall pass prior to acceptance by the City. The continuity test shall be witnessed by the City. The test shall take place during the disinfection process, prior to the City tying services into the main.

When extending water mains, a 1" corporation shall be tapped into new water main within the first 6 feet of new main. When ending water mains, a 1" corporation with 1" copper line extending 1 foot above ground elevation shall be tapped into new water main within the last six feet of new main. 1" copper sampling lines shall be installed every 1000 feet and on any branch over 10' of new water main (hydrant leads extending over 10' are considered a branch) for chlorination and sampling. All water mains shall end with a valve and mechanical joint plug, which shall have a 2" blow-off assembly, this blow off assembly can be used as the end sample point replacing the 1" tap within the last 6' of the new water main. All blow-off assemblies shall become property of the City of Midland Water Department.

During the cold weather months it shall be the contractor's responsibility to insure that stand pipes and sampling points do not freeze. Stand pipes shall be protected by heat tapes or heated boxes with access. Sampling lines shall have the curb stop buried at an acceptable depth as to not freeze and the copper line extending out of the ground. These lines must be protected also. With communication, the City of Midland may assist by pumping out stand pipes and or sample lines; however, the City of Midland will not claim responsibility of any damage due to frozen lines. The ultimate responsibility to protect these lines is to the contractor.

Following pressure testing and disinfection, the Contractor shall remove all sample lines and plug the corporation with a copper disk.

When extending water mains, the Contractor shall install a polyurethane foam pig at the

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beginning of the new main for the purpose of cleaning items from inside the pipe and for removing air during the filling process. To ensure sanitary conditions the polyurethane pigs must be new and unused. Pigs shall be identified by a number in a way that identification can be made upon exit of the swab from pipe. The position and number of the polyurethane foam pig shall be noted on the project's print and a copy sent to City of Midland Water Distribution Department. Foam pigs shall become property of the City of Midland Water Department. All fittings used to flush and remove the pig from the pipe shall be restrained.

9.01.05.01 Horizontal Directional Drilling

- All directional drilling operations shall be performed by a qualified directional drilling contractor. A list of project references and proof of contractor experience shall be presented to the engineer, upon request
- The contractor shall provide all investigation, planning, geotechnical work, equipment, labor, materials, etc. necessary to properly install the proposed directional bores as indicated on the construction drawings using horizontal directional drilling technology. Depths of all existing utilities shall be confirmed by the contractor to avoid conflicts.
- Sufficient space shall be allocated to fabricate and layout the product pipeline into one continuous pipe length, thus enabling the pull back to be conducted during a single operation. The required piping shall be assembled in a manner that does not obstruct adjacent roadways or public activities.
- Drilling fluid shall be used during pilot boring and back reaming operations. The contractor shall provide a slurry containment pit and shall remove all cuttings and excess drilling fluids and dispose of appropriately off-site upon completion. Drilling fluids shall not enter the streets, sewer or natural water bodies. The drilling fluid in the annular region outside of the pipe shall remain in place to provide support for the pipe and neighboring soil.
- The drill path alignment shall be as straight as possible to minimize the frictional resistance during pullback and maximize the length of the pipe that can be installed during a single pull. The overcut diameter shall not exceed the outside diameter of the pipe by more than 1.5 times to ensure excessive voids are not created resulting in post installation settlement.
- The contractor shall maintain instrumentation that will accurately locate the pilot hole and calculate/plot true vertical depth, horizontal distance and right and left bearing drift. The contractor shall verify drill head location and provide accurate as-built data that indicates coordinates of the pipe at least every 25 feet.
- The handling of the joined pipeline shall be in such a manner that the pipe is not damaged by dragging it over sharp or jagged objects. Sections of the pipes with cuts or gouges exceeding 10 percent of the pipe wall thickness or kinked sections shall be removed and replaced. Pipe rollers, skates, etc. shall be used to prevent damage and minimize friction when pulling.
- The manufacturer's recommendations and procedures shall be followed regarding the installation of their pipe material by horizontal directional drilling. The piping shall be installed at the minimum depths indicated in the plans and shall deviate no more than 6 inches along the vertical axis and 2 feet along the horizontal alignment.
- During pipe placement, the contractor shall use appropriate connection

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equipment (such as swivels) to eliminate transfer of rotational forces to the product pipe. The pipe shall be supported so as to minimize friction and ensure a smooth, freely moving pull back. The tensile stress on the pipe shall be measured by the contractor at all times and shall not exceed the maximum allowable tensile stress as recommended by the pipe manufacturer.

9.01.05.02 Jack & Bore Method

- The casing shall be steel pipe, ASTM A53, Grade B, and have a minimum yield strength of 35,000 psi. The casing joints shall be full penetration butt welded continuously over the entire circumference of the pipe and develop the full strength of the casing wall. All welds shall be in accordance with ANSI/AWWA C206. The casing diameter and minimum thickness shall be based on the carrier pipe diameter as per the following table. The contractor shall ensure the casing pipe and welds are sized appropriately to withstand forces applied by the boring equipment.

Carrier Pipe Nom. Dia.	Casing Pipe O.D.	Min. Casing Thickn.
8"	16"	.250"
10"	18"	.250"
12"	20"	.250"
16"	24"	.250"
24"	36"	.312"

- Every effort shall be made to prevent formation of voids. The bore diameter shall not exceed the O.D. of the casing by more than 1". Upon completion of the boring operations, voids around the outside face of the casing shall be filled by pressure grouting. The contractor will be held responsible for repairing any sinkholes or subsidence that develop, at their cost.
- Water main shall have fully restrained joints within the casing.
- D.I. pipe shall be encased in polyethylene within the casing. See 9.01.02.
- Manufactured casing spacers shall be used. Wood skids are not permitted.
- The annular space between the carrier pipe and casing shall be filled with flowable cementitious grout for the entire length.
- The accepted quantities for boring and jacking will be paid at the unit price bid per linear foot of installed casing. All labor, materials and equipment necessary to install the casing will be considered incidental to the casing pay item, except the carrier pipe which shall have a separate pay item.

9.01.06 Hydrants, Valves and Special Fittings

All hydrants, valves, gate valves, Tee's, curves, crosses and connections are to be laid as shown on plans, and as directed. All hydrants leads shall be constructed of D.I. pipe and shall be paid for at contract unit price for six inch D.I. pipe. All bolts and nuts used to assemble valves and hydrants shall be stainless steel. All hydrants shall be wrapped with black plastic until put into service by the City of Midland. All hydrant leads, hydrants, valves, gate valves, Tee's, curves, crosses, valve boxes and connections are to be wrapped in polyethylene plastic to grade.

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9.01.07 Special and Connecting Mains

Special castings, all valves, all hydrants leads and accessories and all connections to other mains shall be placed at the location shown on the plans. The contract unit price, per lineal foot, for laying water main shall be understood to include the cost of furnishing and laying all special castings and connections to other mains and the testing thereof.

9.01.08 Valves and Water Mains

Valves and water mains shall, where possible, be located on the street property lines extended unless shown otherwise on the plans. A valve box or masonry pit shall be provided for every valve.

A valve box shall be provided for every valve that has no gearing or operating mechanism or in which the gearing or operating mechanism is fully protected with a cast iron grease case. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the wrench nut of the valve, with the box cover flush to grade. All valve boxes are to be encased in polyethylene plastic to grade.

Pits shall be so constructed as to permit minor valve repairs and afford protection to the valve and pipe from impact where they pass through the pit walls. The cost of placing or setting of all masonry valve pits and valve boxes is understood as being included in the contract unit price, per lineal foot, for laying water main.

9.01.09 Cross Connection

The Contractor will be required to make all cross connections where required, with water mains crossing or branching from said pipe line as shown on plans, and the capping of all openings left in said pipe line and not connected. The cost of doing such work shall be understood as being included in the contract unit price for laying water mains.

9.01.10 Hydrants and Auxiliary Valves

All hydrants shall be set plumb at the location and grade as given by the Engineer; and payment for setting the hydrants shall be understood to be the contract unit price per each, for setting hydrants. Hydrant extension kits will not be allowed to bring hydrants to grade. A drainage bed consisting of one third yard of pea gravel shall be provided at the base of each hydrant before backfilling. All hydrants and auxiliary valve boxes shall be encased in polyethylene plastic to grade.

9.01.11 Blocking Pipe

All bends, curves, tees, hydrants, and dead ends of pipe and special castings shall be blocked with retainer glands or mega-lugs. All bends, curves, tees, and dead ends of pipe and special castings over ten inches in diameter shall also be blocked with concrete in accordance with the detail plans. Retainer glands shall not be used to restrain PVC pipe. Mega-lug for PVC, pipe clamps, concrete blocking are approved methods to restrain PVC pipe and fittings. The cost thereof is understood to be included in the contract unit price, per lineal foot, for laying water main or per each for setting hydrants.

9.01.12 Pipe Cutting

Whenever it becomes necessary to cut a ductile cast iron pipe to make a connection or closure in either old or new work, the pipe shall be cut on the shortest outside circumference. Flame or electric arc cutting shall not be permitted. Sharp outside edges

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on pipe ends at cuts shall be ground smooth to prevent damage to the joint gaskets.

9.01.13 Pressure Leakage Testing

Pressure Leakage Test for Ductile Iron and C-909 Pipe

Prior to filling new water mains with water, the Contractor shall install polyurethane foam Poly-Pig into the main for the purpose of cleaning items from inside the pipe and for removing air during the filling process. After the entire water main, or any part of the water main located between two gate valves has been constructed and approved by the Engineer, the City Water Department shall flush, disinfect and sample the new portion of water main using the procedures as described in section 9.01.14 located on page 4 of this document.

Once it is determined that the main has passed the bacteriological testing requirements , (by process of two concurrent clean samples taken 24 hours apart) the installed main and appurtenances shall be capable of meeting the requirements imposed by a pressure leakage test given as follows:

Note: All equipment used in the pressure leakage test shall be clean and properly disinfected so as to not allow introduction of contaminants into the water main during testing procedures. All pressure tests are to be performed by connecting to the furthest point possible from the entry point connection of the project so that water used during testing procedures can be evacuated from the main without traveling through entire project.

AWWA Standard C600

WARNING: The testing methods described in this section are specific for water pressure testing. These procedures should not be applied for air pressure testing because of the serious safety hazards involved.

Test Restrictions:

The hydrostatic test pressure shall be 150 PSI

The hydrostatic test shall be of a least 2 hours duration.

The test pressure shall not vary by more than + or - 5 PSI for the duration of the test.

Pressurization:

Water pressure testing shall be completed between two valves. This will limit the amount of water main which can be tested at one time and isolate leaks if present. The completed pipe line valves shall be slowly filled with disinfected water until all air has been expelled. When certain that all air has been expelled from the pipe line, the water pressure shall be raised to 150 pounds per square inch and shall be maintained at this pressure for a period of at least two hours.

Testing Allowance Defined:

Testing allowance shall be defined as the quantity of makeup water that must be supplied into the newly laid pipe or any isolated section thereof to maintain pressure within 5 PSI of the specified test pressure after the pipe has been filled with water and the air has been expelled. Testing allowance shall not be measured by a drop in pressure in a test section over a period of time.

Testing Allowance:

No pipe installation will be accepted if the amount of makeup water is greater than that determined by the following formula or table 1.1 located on the next page.

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$$L = \frac{SD\sqrt{P}}{148,000}$$

Where:

L= Testing allowance (makeup water), in gallons per hour

S= length of pipe tested, in feet

D= nominal diameter of pipe, in inches

P= average test pressure during the hydrostatic test, in pounds per square inch (gauge)

Table 1.1

Pipe Size (dia.)	4	6	8	10	12	14	16	18	20	24	30	36
Allowable Leakage gph/1000 l.ft. (2 Hour Test)	0.66	1.0	1.32	1.66	1.98	2.32	2.64	2.98	3.32	3.98	4.96	5.96

If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size. If the pipe line does not meet the leakage requirement, the pipe line may be allowed to stand under normal City pressure for twenty-four hours to three days, and the test again repeated.

Note: During this time if a joint or joints indicate an undue amount of leakage by either showing up on the surface or by indication with sound testing equipment, said joint or joints shall be uncovered and repaired before other tests are made, all repair work shall be witnessed by Water Distribution personnel to be sure sanitary procedures are followed. If Water Distribution personnel are not present during repairs, the water main will need to be re-chlorinated, then bacteriological testing performed and passed before any pressure above normal City pressure can be placed on the water main.

Pressure Leakage Test for HDPE Pipe

Pressure testing procedure shall be per Manufacturer's recommendations or as follows taken from the PPI Technical Report TR-31 by the Plastic Pipe institute:

1. **Initial Expansion** – Gradually pressurize the test section to test pressure of 150 PSI and maintain test pressure for 3 hours. During the initial expansion phase, HDPE pipe will expand slightly. Additional water will be required to maintain pressure. It is not necessary to monitor the amount of water added during the initial expansion phase.
2. **Test Phase** – Immediately following the initial expansion phase, monitor the amount of make-up water required to maintain the test pressure for two (2) hours. If the amount of make-up water needed to maintain test pressure does not exceed the amount in table 1.2, no leakage is indicated and the pipe has passed the pressure test.

Nominal Pipe Size (in)	Make-up Water Allowance for Test Phase (U.S. Gal/100 ft of pipe)		
	1- Hour test	2-Hour Test	3-Hour Test
2	0.07	0.11	0.19
3	0.10	0.15	0.25

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4	0.13	0.25	0.40
6	0.30	0.60	0.90
8	0.50	1.00	1.50
10	0.80	1.30	2.10
12	1.10	2.30	3.40
16	1.70	3.30	5.00
18	2.00	4.30	6.50
20	2.80	5.50	8.00
24	4.50	8.90	13.30
36	9.00	18.00	27.00
48	15.00	27.00	43.00

All visible leaks are to be repaired regardless of the amount of leakage.

The Contractor must submit his plan for testing to the City of Midland Engineering for review at least 10 days before starting the test and shall notify the Engineering Department a minimum of 48 hours prior to test.

Note: All equipment used in the pressure leakage test shall be properly disinfected so as to not allow introduction of contaminants into the water main during testing procedures.

9.01.14 Disinfection

The City of Midland Water Distribution Department will handle all disinfection processes of the new water main utilizing the continuous feed method of AWWA Standard C651.

Upon completion of the new water main installation, City of Midland Water Distribution personnel will inspect the project to determine the following criteria are met: the first sample point is within 10' of the connection point, no sample point is greater than 1200' of each other, and there are sample points on each branch greater than one pipe length.

City of Midland Water Distribution personnel will then determine the pipe volume using field data of pipe length and pipe diameter installed. The optimal flow rate will be determined to use the continuous injection method of chlorination. If flow rates are determined to be 250 GPM or lower distribution personnel will use a 3" flow meter to set flow rate. If flow rate is determined to be 500 GPM or higher a pitot gauge will be utilized using a flow pressure to determine GPM. Distribution personnel will then begin the continuous injection process using a diaphragm pump set at 7.7 GPM.

The chlorine solution is mixed in a 50 gallon tank using 65% calcium hypochlorite granules in the following amounts, ½ lb. of granules for a flow rate of 250 GPM or 1 lb. of granules for a flow rate of 500 GPM. If more than one tank is needed distribution personnel communicate by radio, simultaneously closing termination point valve and shutting off pump, a by-pass valve will be open to allow continuous flow through feed valve. More solution may then be mixed and the process continued. Distribution personnel will test flow using drop dilution method of testing for free chlorine until a solution of 25 PPM free chlorine is achieved, crews will continue to run pump while drawing solution into all hydrants, branches and sample points. After feed valve is closed and pump is off, crews will operate ALL other valves up and down to "dip" gates into chlorine solution.

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City of Midland Water Distribution personnel will utilize Option B for bacteriological verification (Section 5.1.1.1 of Standard C651) for the pre-pressure test sampling process. After chlorine solution has had minimum 24 hour contact time, chlorine residual will be taken to determine that it contains a minimum of 10 PPM free chlorine residual. The water main will then be flushed off until free chlorine residual is no higher than distribution system free chlorine residual. The water main will then be turned off to allow another 16 hours of contact time. **WITHOUT FLUSHING**, Distribution personnel will collect the first sample from each sample point, leaving the water running after collection. After a minimum of 15 minutes a second set of samples will be taken from each sample point. All sample points and the water main will then be shut down. Both samples must test negative for coliform bacteria which is a 24 hour Colilert test. After two consecutive samples pass, the water main can then be pressure tested using procedures found in section 9.01.13 Pressure Leakage Testing.

Once the new water main has passed the pressure test, City of Midland Water Distribution personnel will utilize Option A for the final bacteriological verification (Section 5.1.1.1 of Standard C651) The water main will be flushed, then allowed to sit for a minimum of 16 hours contact time. The first set of samples will be taken from each sample point then the water main will be shut down. After another minimum 16 hour contact time the second set of samples will be taken. In addition to being tested for coliform bacteria these final two samples will also be tested for HPC bacteria which requires a 48 hour test period. These samples must both pass. When two consecutive samples have passed, the Contractor may then remove all sample lines. After all sample lines have been removed City of Midland Water Division will then assume possession of the water main, Distribution personnel will flush the new water main one last time and open it to the distribution system.

9.01.15 Live Connections

The City Water Department shall make all live connections into the City's pressure distribution system. It is the City's policy that any connection that is smaller than the main being connected to shall be a "hot tap" connection. Example: if an 8" water main is needed for the project and the existing water main is 10", then a hot tap will be required. The contractor is to supply the materials for all hot tap projects. The contractor may perform the excavation for the project to save on labor, however; the excavation must be to City of Midland standards. Connections where the existing water main is the same size or smaller than the size needed for the project requires a "cut in" connection. "Cut in" connections will be completely performed by the City of Midland due to the fact that all parts must be chlorinated and sanitized prior to the work being performed. This will be invoiced as a time and material job. In both instances the contractor will be invoiced for a project deposit from Water Distribution which must be paid prior to the work being performed. Once the work is completed the project funds will be reconciled.

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9.01.16 Backfilling Open Trenches (Non-Roadway Areas)

Class II sand shall be placed and tamped along the sides of the pipe line up to at least one foot above the top of the pipe for the full width of the trench before any other backfill material is placed over the pipe. The remaining portion of the trench shall then be backfilled with material excavated; but care shall be given to make sure that all stones, pieces of concrete and other materials which might damage the pipe are not placed in the backfill. Fly ash or cinders shall not be permitted to be used as backfill. When a machine is used to place the backfill material, no material shall be dropped into the trench but shall be placed on the sloping end of the completed backfill and allowed to roll into place to the bottom of the trench.

Should any deficiency in the backfilling occur, in either quantity or quality of excavation materials taken from the trench, the Contractor shall supply the deficiency without extra charge to the City. No foreign or perishable materials shall be used in the backfilling.

All trenches between the sidewalk line and the shoulder of the road shall be left with a sufficient mound of earth above the original surface, as is deemed necessary by the Engineer, to take care of future settlement. All backfill in trenches between the shoulders of the roadway or in driveways and gravel streets shall be resurfaced to equal the original amount of gravel before construction.

9.01.17 Backfill in Tunnel

A good grade of clean river sand or concrete sand mixed in the proportions of one sack of Portland Cement to one cubic yard of sand shall be slightly dampened and tamped in and around the pipe and all the way to the roof of the tunnel. Shoring and bracing used to support the tunnel roof shall be removed as the backfill material is tamped in place. The cost of furnishing materials and making backfill in tunnel or in cuts through existing structures shall be understood to be included in the contract unit price, per lineal foot, for laying water main.

9.01.18 Backfilling under Roadways, Etc.

Trenches excavated through cuts in existing pavements, shoulders, curbs, sidewalks, roadways and driveways shall be backfilled with Class II sand and compacted in lifts to 95% of the maximum unit weight of the material. Coarse aggregate backfill, where specified, shall be compacted in lifts to 98% of the maximum unit weight of the material.

When water main is constructed under existing pavement curb sidewalk, crosswalk, or in the parkway or lawn area, the Contractor, at his own expense, shall for a period of one year from the payment of the final estimate make additional fills wherever settlements have taken place and restore the pavements, curbs, lawn and other public fixtures wherever settlement or displacements have taken place, along the line of work.

9.01.19 Surplus Earth

Surplus earth is understood to mean the excess of earth excavated and remaining after the required backfill hereinbefore specified is completed.

The unexcavated portions of the roadway surface shall be left in its original condition, graded free of any clay deposits. All ditches shall be cleaned to grade set by the Engineer. No surplus earth will be left in the road ditches except by permission of the Engineer. If such permission is granted the earth shall be graded in accordance with grade stakes set by the Engineer.

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9.01.20 Miscellaneous

All sidewalks and crosswalks are to be left in as good condition as that in which they were found.

All trees shall be protected from any and all damages and shall be boxed at least six feet high in a substantial manner and any damages or injury to any tree shall be treated and repaired by a tree specialist at the expense of the Contractor.

All lawns disturbed or damaged by reason of the operations shall be replaced by the Contractor at his expense in equally as good condition as found and in a manner satisfactory to the Engineer.

Whenever any pavement curb, sidewalk, or other public fixture is removed without authority or damaged by reason of the operation and construction of the work to be done under this contract, the same shall be replaced to the satisfaction of the Engineer without expense to the City.

The City Water Department shall be responsible for the flushing, disinfection testing for bacteria, and placing into service of the newly installed main.

Following pressure testing and disinfection, the Contractor shall remove all sample lines and plug the corporation with a copper disk.

9.01.21 Method of Measurement

Measurement of water main constructed will be made in lineal feet on the axis of the pipe laid from the beginning to the end and shall include measurements through special castings and valves. Hydrant leads will be measured in lineal feet through valves and special castings from the center of the supplying water main, on the axis of the pipe, to the center of hydrant. Branches will be measured in lineal feet from the center of the tee or cross, on the supplying water main, to the end of the pipe or special casting including the cap and plug in the case of a dead end.

Setting of hydrants will be measured in units.

Pavement replaced will be measured in square yards of surface.

9.01.22 Basis of Payment

"Construction of Water Mains" will be paid for at the Contract unit price, per lineal foot, for each size of pipe, which price shall be payment in full for furnishing the necessary materials as specified, excavating, laying, blocking, testing, backfilling, cleaning up, grading, and completing the water main all in accordance with the detailed specifications.

"Setting Hydrants" will be paid for at the contract unit price per each, which shall be payment in full for furnishing the necessary material, excavating, setting, blocking and backfilling in accordance with the detailed specification.

"Pavement Replaced" will be paid for at the Contract unit price, per square yard, which shall be payment in full for furnishing the necessary concrete materials, reinforcing steel, mixing and placing the pavement replacement complete in accordance with the detailed specifications.

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9.03 SPRINKLER SYSTEM

9.03.01 Description of Work

The sprinkler system shall be constructed using the sprinklers, valves, piping, fittings, controllers, wiring, pumps, etc., of sizes and types as shown on the drawings and as called for in these specifications. The system shall be constructed to grades and conform to areas and locations as shown on the plans.

Contractor shall be responsible for all sprinkler work beyond the Tapping of the water main. OWNER WILL MAKE LIVE CONNECTION AND FURNISH AND INSTALL WATER METER. Control cabinet with will be installed by the City as indicated on the drawings.

9.03.02 Description of System

Sprinkler lines shown on the drawing are essentially diagrammatic. Locations of all sprinkler heads, valves, piping, wiring, etc. shall be established by the contractor at the time of construction. Spading of the sprinkler heads or quick coupling valves are shown on the drawing and shall be exceeded only with the permission of the Owner's Authorized Representative.

Unless otherwise specified or indicated on the drawings, the construction of the sprinkler system shall include the furnishing, installing, and testing of: all mains, laterals, risers and fittings, sprinkler heads, quick coupling valves, gate valves, control valves, controllers, electric wire, pumps, controls and all necessary specialties. The removal and/or restoration of existing improvements, excavating and backfill, and all other work in accordance with the plans and specifications shall be included as required for a complete system.

9.03.03 Description of Material

The contractor shall use material as specified on the irrigation Plan. Material other than specified will be permitted only after written application by contractor and written approval by the owner prior to bid opening. Substitutions will only be allowed when in the best interest of the owner.

9.03.04 Equipment, Tools, and Labor

The contractor shall furnish all such equipment, tools, and labor necessary to pursue work in an acceptable manner, to a speedy completion. This contract is based on the contractor furnishing and using his own equipment, tools, and labor which are suitable to carry out this contract in a first class manner, unless otherwise herein specified.

9.03.05 Equipment, Tools, and Labor

The contractor shall keep the premises free from rubbish and debris at all times and shall arrange his material storage so as not to interfere with the owner's operation of the job. All unused materials, rubbish, and debris shall be removed from the site.

9.03.06 Examination and Verification of Drawings and Site

It shall be the contracting installer's responsibility to report to the owner's authorized representative any deviations between mechanical drawings, specifications and the site. Failure to do so prior to the installing of equipment and resulting in replacing, and/or relocation equipment shall be done at the contractor's expense.

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9.03.07 Excavation and Backfill

Trenches for plastic pipe or sprinkler lines shall be excavated of sufficient depth and width to permit proper handling and installation of the pipe and fittings. The piping may be installed by any other method the contractor may desire if approved by the owner and the pipe manufacturer. The backfill shall be thoroughly compacted and evened off with the adjacent soil level. All areas shall be completely backfilled with granular material and compacted to 95% of its maximum unit weight. All trenches that are opened during any particular working day shall be closed and backfilled the same day. No open trenches or partially backfilled trenches shall be left overnight. All sod shall be removed and restored. If sod is not restorable, it shall be contractor's responsibility to repair and reseed damaged areas. Any or all lines may be installed without sod removal by use of a vibratory plow, providing sufficient depth of cover is maintained.

1. Depth of cover from finish grade shall be as follows:

Main/line	3" and smaller
Min:	12" of cover
Lateral Line	2" and smaller
Min:	10" of cover
Sleeving	All sizes
Min:	18" of cover

9.03.08 Unclassified Excavation

Excavation shall be unclassified and shall include all materials encountered. All materials or matter that cannot be excavated by normal mechanical excavation means shall be brought to the attention of the owner's representative and an adjustment in price agreed upon before excavation of these areas proceeds.

When additional backfill materials are needed to replace rock and/or other unsuitable materials, it shall be the contractor's responsibility and expense to supply such material for backfill to the irrigation contractor. It shall also be the contractor's responsibility to dispose of the unsuitable materials removed from the ranch that cannot be used in the backfill operations, unless otherwise agreed upon by the owner and contractor.

9.03.09 Existing Utilities and Structures

The exact location of all existing utilities, structures, and underground utilities, which may not be indicated on the drawings, shall be determined by the contractor and he shall conduct his work so as to prevent interruption of service or damage to them. The contractor shall protect existing structures and utility services and be responsible for their replacement if damaged by him, or to make necessary adjustment in their location if required in order to complete the work of this contract.

9.03.10 Ordinances and Regulations

All local, municipal, and state laws, rules and regulations governing or relating to any portion of this work are hereby incorporated into and made part of these specifications, and their provisions shall be carried out by the irrigation contractor. Anything contained in these specifications shall not be constructed to conflict with any of the abovementioned rules or regulations. However, when these specifications and/or drawings call for or describe materials, workmanship, or construction of a better quality, higher standard or larger size, these specifications and/or drawings shall take precedence over the requirements of said rules, regulations, or codes.

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9.03.11 Permits and Inspections

Any permits for the installation or construction of any of the work included under this contract, which are required by any of the legally constituted authorities having jurisdiction, shall be obtained and paid for by the contractor, each at the proper time. He shall also arrange for and pay all costs in connection with any inspection and examination required by these authorities.

At the request of the owner's representative, the irrigation consultant will inspect the installation and make recommendations to the owner's representative for any necessary changes, corrections, etc. The contractor shall pay all federal, state, or local taxes, sale and/or use taxes, applicable to all materials, processes or devices purchased or used in connection with the work under this contract.

9.03.12 Changes or Additional Work

The owner may, without invalidating the original contract, order such changes or additions as may from time to time be deemed desirable or necessary. In so doing, the contract price shall be adjusted to the mutual agreement of the contractor and owner. Extensions of completion time will be adjusted as necessitated by changes. The contractor shall bring to the attention of the owner's authorized representative, and they shall together work out an agreeable change, which may be necessitated by deviations in construction from original plans by other contractors on the job. Any change in price brought about by such deviations in construction over original plans by other contractors shall be agreed upon by both the contractor and the owner before work proceeds.

Any changes deemed necessary by the contractor concerning sprinkler head placement or zoning, controller or pump location, etc. shall be submitted to the owner's authorized representative before such work is begun.

9.03.13 Record Drawings

The owner will furnish the contractor with one set of blueline prints, showing all sprinkler work required under this contract, for the purpose of having the contractor record on these prints all changes that may be made during actual installation of the system. Immediately upon installation of any piping, valves, wiring, sprinkler heads, etc., in locations other than shown on the original drawings, or of sizes other than indicated, the contractor shall clearly indicate such changes on the set of drawings, (see also Changes or Additional Work). After final acceptance of the completed installation, the contractor shall be responsible for having complete drawings prepared showing all such changes and these shall be turned over to the owner for recording purposes. (See also Owner's Acceptance.)

9.03.14 Guarantee

It shall be the contractor's responsibility to insure and guarantee complete coverage of the areas shown on the drawings to be irrigated. He shall also guarantee the satisfactory operations of the entire system and the workmanship and restoration of the area. Adjustment of the sprinkler heads and automatic equipment will be done by the contractor, upon completion of installation, to provide optimum performance. The entire system shall be guaranteed to be complete and perfect in every detail for a period of one year from the date of its acceptance, and he HEREBY AGREES to repair or replace any such defects occurring within that year, free of expense to the owners.

The irrigation contractor shall be responsible for blowing out the system by air compression in the fall following installation and turning on the system in the following spring.

9.03.15 Notice of Completion

The completion of the contract will be accepted, and Notice of Completion recorded only when the entire contract is completed to the satisfaction of the owner's authorized representative.

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9.03.16 Owner's Acceptance

The contractor will furnish the owner with two (2) sets of: (1) a product folder showing all major components of the system, and (2) an instruction manual explaining how the system operates.

Within ten (10) days of the contractor's notification that the installation is complete, the owner will inspect the installation and, if final acceptance is not given, will prepare a "punch list" which, upon completion by the contractor, will signify acceptance by the owner.

In lieu of final acceptance punch list, the job shall be considered accepted when the owner takes over full operation of the system.

Final payment will not be made without the receipt of an accurate as-built drawing by the owner. The as-built drawing should have dimensions from stationary points as they relate to valves, (electric, manual, drain, and quick coupler) main lines, and wire. After completion, testing, and acceptance of the system, the contractor will instruct the owner's personnel in the operation and maintenance of the system. Contractor shall provide owner with two sets of parts lists and instructions.

9.03.17 Materials

All materials to be incorporated in this system shall be new and without flaws or defects and of quality and performance as specified and meeting the requirements of this system. All material averages at the completion of the installation are the property of the contractor and are to be removed from the site.

1. Pipe and Fittings.

Pipe sizes shall conform to those shown on the drawings. No substitutions of smaller pipe sizes will be permitted, but substitutions of larger size may be approved. All pipe damaged or rejected because of defects shall be removed from the site at the time of said rejection.

a. Mainline Piping

Mainline piping shall be rigid unplasticized PVC-Class 160 PSI working pressure extruded from virgin parent material of the type specified on the drawings. The pipe shall be homogeneous throughout and free from visible cracks, holes, foreign material, blisters, deleterious, wrinkles, and dents.

b. Lateral Piping

All lateral pipe shall be flexible, non-toxic polyethylene pipe bearing the NSF seal. All sizes shall have a minimum of 80 PSI working pressure rating. All stainless steel clamps shall be used to secure joints. Joints 1 1/4" and larger shall be double-clamped. All plastic pipe shall be continuously and permanently marked with the manufacturer's name, material, size, and schedule type.

c. Sleeves

- (1) Pipe sleeves shall be PVC Class 160 BE.
- (2) The above sleeve or polyethylene may be used in zone section piping.

2. Plastic Pipe Fittings and Connections.

All plastic pipe fittings to be installed shall be molded fittings manufactured of the same material as the pipe and shall be used except brass saddle tees and crosses as hereinafter specified.

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Slip fitting socket taped shall be so sized that a dry unsoftened pipe end, conforming to these special provisions, can be inserted no more than halfway into the socket. Plastic saddle and flange fittings will not be permitted. Only Schedule 80 pipe may be threaded.

9.03.18 Installation of PVC Pipe

Plastic pipe shall be installed in a manner so as to provide for expansion and contraction as recommended by the manufacturer.

Plastic pipe shall be cut with a hand saw or hacksaw with the assistance of a square in sawing vice, or in a manner so as to ensure a square cut. Burrs at cut ends shall be removed prior to installation so that a smooth unobstructed flow will be obtained.

All plastic-to-plastic joints shall be solvent-weld joints or slop seal joints. Use only the solvent recommended by the pipe and fittings manufacturer, and it shall be the contractor's responsibility to make arrangements with the pipe manufacturer for any field assistance that may be necessary.

The contractor shall assume full responsibility for the correct installation. All pipe shall be treated with the recommended primer before solvent welding.

The solvent weld joints shall be made in the following manner:

1. Thoroughly clean the mating pipe and fitting with a clean, dry cloth.
2. Apply primer.
3. Apply a uniform coat of solvent to the outside of the pipe with a non-synthetic bristle brush.
4. Apply solvent to the fitting in a similar manner and quickly insert it into the fitting.
5. Give the pipe or fitting a quarter turn to insure even distribution of the solvent and make sure the pipe is inserted to the full depth of the fitting socket.
6. Hold in position for 15 seconds.
7. Wipe off excess solvent that appears at the outer shoulder of the fitting.

Care should be taken so as not to use an excess amount of solvent, thereby causing a burr or obstruction to form on the inside of the pipe. The joints shall be allowed to set at least 24 hours before pressure is applied to the system.

9.03.19 Installation of Polyethylene Pipe

Polyethylene pipe shall be cut with a hand saw or a hack saw with the assistance of a square in vice or in a manner so as to ensure a square cut. Burrs at cut ends shall be removed prior to installation of fittings so that a smooth unobstructed flow will be obtained.

All Polyethylene joints shall be made using ASTM-D-2609; insert fittings should be put in the pipe all the way up to the stop.

A very slight heating of the pipe eases insertion of the fittings; use of hot water is recommended. Overheating or using lubricants negates pipe warranty.

Clamp all fittings on barbed surface of fittings.

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9.03.20 Installation of Sleeves

Sleeves shall be installed as indicated on the drawings. Joints shall be installed in accordance with manufacturers recommendations. After water main is installed through sleeve, the ends of sleeves shall be positively sealed with an expandable foam to prevent infiltration into the sleeve. Sealed ends shall have weep holes to allow moisture to escape from the sleeve.

9.03.21 Sprinkler Heads

Full or Part Circle High Pop-Up Spray Sprinkler Model 1804

The full or part circle pop-up spray sprinkler shall be capable of covering 12 to 5 feet radius (FT.RAD.) at 30 pounds per square inch (PSI) with a discharge rate of 1.8 to 4.3 gallons per minute (GPM).

The sprinkler body, stem, nozzle, and screen shall be constructed of heavy duty plastic.

The sprinkler shall have a soft elastomer pressure activated co-molded wiper weal for cleaning debris from pop-up stem as it retracts into case to prevent sprinkler from sticking up.

The sprinkler shall have a matched precipitation rate (MPR) plastic or brass nozzle with an adjusting screw capable of regulating the radius and flow.

The sprinkler shall have a strong stainless steel retract spring for positive pop-down. Pop-up height shall be no less than 4 inches.

The sprinkler shall have a ratcheting system for easy alignment of pattern.

The sprinkler shall have a screen under the nozzle to protect it from clogging and for easy removal for cleaning and flushing system.

The sprinkler shall be as manufactured by Rain Bird Sprinkler Mfg. Corp., Glendora, California.

9.03.22 Sprinkler Connections

The sprinkler heads shall be connected to the lateral or main as indicated on the drawings.

All quick coupler valves shall be connected to the main by use of the three (3) elbow PVC Schedule 80 swing joints.

All sprinkler heads shall be positioned to prevent contact with lawn mowers.

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9.03.23 Electric Remote Control Valve Model 100-PGA

The remote control valve shall be a normally closed 24 VAC 50/60 cycle solenoid actuated globe/angle pattern with a balanced pressure diaphragm design capable of having a flow rate of 30 gallons per minute (GPM) with a pressure loss not to exceed 5 pounds per square inch (PSI). The valve pressure rating shall not be less than 150 PSI.

The valve body and bonnet shall be constructed of high impact weather resistant PVC with stainless-steel screws. The valve shall have the following recommended continuous pressure ratings at the temperature indicated.

Temperature	Pressure (continuous)
73 F.	150 PSI
80	132
90	112
100	93
110	75

The valve shall have manual open/close control (internal bleed) for manual opening and closing of valve without electrically energizing the solenoid. The valve's internal bleed shall prevent flooding of the valve box. The valve shall house a fully-encapsulated, one-piece solenoid. The solenoid shall have a captured plunger with a removable retainer for easy servicing, and a leverage handle for easy turning. This 24 VAC 50/60 Hz solenoid shall be actuated by .41 amps inrush current (9.9 VA) and .25 amps holding current (5.5 VA).

The valve shall have a flow control stem for accurate manual regulation and/or shut off of outlet flow. The valve must open or close in less than 1 minute at 150 PSI, and less than 30 seconds at 20 PSI.

The valve construction shall be such as to provide for all internal parts to be removable from the top of the valve without disturbing the valve installation. The body shall have a removable O-ring plug for installation in either globe or angle configuration.

The valve shall be as manufactured by Rain Bird Sprinkler Mfg. Corp., Glendora, California.

9.03.24 Electric Valve Installation

Electric valve installation shall be as indicated in the specifications or drawings. All electrical valves shall be enclosed in a minimum ten (10) inch width valve box or pit.

9.03.25 Controllers Model ESP-16LX

Hybrid Controller

The controller shall be of a hybrid type that combines electro-mechanical and micro-electronic circuitry capable of fully automatic or manual operation. The controller shall be housed in a wall-mountable, weather resistant, plastic cabinet suitable for either indoor or outdoor installation.

The controller shall have 12 stations, with each station capable of an operating time of 0 to 99 minutes in 1 minute increments. The controller shall have a 365-day calendar and shall feature a range of operating day cycles or odd day, even day, variable day or custom schedules.

The controller shall have four separate programs (A, B, C, & Drip) which can have different start times, watering days, and station timing. Each program shall have up to 6 start times available per day. The controller shall be capable of operating two 24 VAC solenoid valves per station plus a master valve or pump start relay.

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The controller shall have a water budget feature adjustable from 10% to 200% of actual time set on the stations in 10% increments. The controller shall be capable of stacking start times between programs.

The controller shall have a 12 hour AM/PM clock with a midnight day changeover. The controller shall have a 9-volt Ni-Cad rechargeable batter backup feature to maintain program memory during power outages. The controller shall have a diagnostic circuit breaker that skips stations with overloaded or shorted circuits and displays the station.

The controller shall be manufactured by Rain Bird Sprinkler Mfg. Corp., Glendora, California.

9.03.26 Control Wire

Control wire shall be type UF for direct burial underground and shall be size 14-1.

Joining of underground wires shall be by use of 3MDBY connectors.

9.03.27 Backflow Prevention- Watts 800M 2QT – 1” Pressure Vacuum Breaker

Approved backflow prevention shall be provided as called for on the plans. In automatically controlled system, one pressure-type vacuum breaker shall be permitted when installed upstream of all automatic zone control valves. The pressure vacuum breaker shall be installed a minimum of 14” above the highest sprinkler. If an automatic master control valve is used, it shall open at the beginning of the sprinkling cycle and shall close at the end of the sprinkling cycle.

9.03.28 Cathodic Protection

Cathodic protection shall be provided in the piping system by installing insulating type couplings, flanges, or unions between copper tubing and steel pipe.

9.03.29 Flushing and Testing

Testing of the system shall be performed after completion of each section and at completion of the entire installation. The final testing shall be in the presence of the owner’s representative. Any necessary repair shall be made, at the contractor’s expense, to put the system in good working order before final payment by the owner.

9.03.30 Basis of Payment

“Sprinkler system” will be paid for at the contract lump sum price for each phase installed, which price shall be payment in full for furnishing and installing the necessary materials as specified, excavating, laying, backfilling, cleaning up, testing, and completing the sprinkler system in accordance with the detailed specifications.