SECTION 02713

WATER MAINS

PART 1 - GENERAL

1.1 DESCRIPTION

This section contains information required to furnish and install water distribution lines, fittings, valves, hydrants, and accessories as well as making all connections, disinfection, and testing of the constructed lines.

1.2 WORK INCLUDED

All labor, equipment and material necessary to complete the work stipulated herein and indicated in the plans. The Contractor shall remove so much of the pavement as may be necessary; excavate the trenches and pits to the required dimensions; excavate the bell holes; construct and maintain all bridges required for traffic control; sheet, brace and support the adjoining ground or structures where necessary; handle all drainage or ground water; guard the site; unload, haul, distribute, lay and test the pipe, fittings, valves, hydrants, and accessories; rearrange the branch connections to main sewers, or rearrange other conduits, ducts or pipes where necessary; replace all damaged drains, sewers, or other structures; backfill the trench pits; restore the roadway surface unless otherwise stipulated; remove surplus excavated material; clean the site of the work; chlorinate the completed pipe line, and have samples checked and approved for bacteriological analysis by the State Board of Health; and maintain the street or other surface over the trenches.

1.3 SUBMITTALS

Submit product data sheets showing materials, operating characteristics, test reports and shop drawings for all proposed materials to be incorporated in the project. Submit a pressure and bacteriological test schedule as required in the specifications at least 14 days prior to beginning of testing.

1.3.1 As-Built Drawings: Prior to submitting the Final Estimate for payment, the Contractor shall provide to the Engineer a record set of As-Builts indicating the exact location of all hydrants, valves, tees, and mains for this project. The As-Builts shall be precise and neat such that the Owner can locate the new water main appurtenances in the field without damaging other utilities. Contractor shall locate all mains, hydrants, meters, valves, etc. using GPS equipment that will tie to the Utilities Board existing mapping system.

1.4 INSPECTION

1.4.1 Material at Factory: At the discretion of the Engineer, all materials are subject to inspection and approval at the plant of the manufacturer. All materials shall meet the requirements hereinafter specified, and the Contractor shall have made by a Laboratory, approved by the Engineer, tests showing the material does meet the specifications. The records of the test shall be furnished prior to the pipe being laid. The cost of such test will be borne by the Contractor.

1.4.2 Materials at Delivery Point: During the process of unloading, all pipe and accessories shall be inspected by the Contractor for loss or damage in transit. All pipe and accessories are subject to inspection at the point of delivery by the Engineer. The Engineer may perform tests as specified in the referenced Standards to ensure conformance with those standards.

1.4.3 Field Inspection: 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 his approval.

1.4.4 Disposition of Defective Material: 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.

1.5 HANDLING PIPE AND ACCESSORIES

1.5.1 General: All pipe, fittings, valves, hydrants, and other accessories shall, unless otherwise directed, 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 or slid or rolled on skidway 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. Sensitive and easily damaged materials shall be stored at an indoor location. All openings in equipment and accessories shall be securely plugged or covered until the moment that connections are actually made.

1.5.2 Unloading: 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 repaired in a manner satisfactory to the Engineer. Pipe shall be placed on the site of the work parallel with the trench alignment and with bell ends facing the direction in which the work will proceed unless otherwise directed. The interior of all pipe, fittings, and other accessories shall be kept free from dirt and foreign matter at all times.

PART 2 - PRODUCTS

2.1 POLYVINYL CHLORIDE (PVC) PIPE

PVC pipe shall be supplied by a major manufacturer approved by the Engineer. Pipe shall be NSF approved for potable-water service.

PVC or D.I. fittings may be used on PVC pipe with diameters smaller than 3 inch. Ductile iron fittings shall be used on pipes 3 inch and larger. The bells and PVC fittings used on PVC pipe shall be manufactured by the same company that manufactured the pipe. Solvent cement connectors shall not be allowed.

2.1.1 C-900 (4 Inch thru 12 Inch): Polyvinyl Chloride Pipe, PVC pipe and couplings shall be PVC 1120 pressure pipe made from Class 12454-A or 12454-B material and conforming to the applicable portions of AWWA Standard C-900-75. The outside Diameter (OD) dimensions of cast-iron pipe (CI) shall be used with the minimum wall thicknesses of DR series 18 for Pressure Class 150 pipe and DR 14 for Pressure Class 200 pipe, as detailed in Table 2 of AWWA Standard C900-75.

The joints shall be designed so that the pipe and fittings may be connected on the job without the use of solvent cement or any special equipment.

Gaskets and lubricants shall be non-toxic, shall not support the growth of bacteria, shall be compatible with pipe material and each other and shall not impart color, taste or odor.

2.1.2 PSI Rated PVC Pipe (1½ Inch thru 12 Inch): Polyvinyl Chloride Pipe (PVC) for small diameters and PSI rated PVC pipe shall be Type I, Grade I, PVC meeting the requirements of ASTM D-1784 and applicable provisions of ASTM D-2241. Pipe shall be made of all virgin material and conform to Commercial Standard CS-256-63 and approved by NSF for potable water usage.

Pressure Class: Pipe shall have a pressure class rating of 200 psi unless otherwise approved by the Owner.

Joints: The joints shall be designed so that the pipe and fittings may be connected on the job without the use of solvent cement or any special equipment.

SDR: 200 PSI, Min. SDR 21 or 250 PSI, Min. SDR 18.

All PVC water main shall be white or blue in color.

2.1.3 Detector Wire

A continuous single strand solid copper #12 AWG detector wire shall be placed approximately 6" over all PVC pipe. At all valves and fire hydrants not provided with a shut off valve, provide a continuous loop to ground level in valve boxes or to ground level at the fire hydrant side facing the nearest street.

2.1.4 Saddles: Approved saddles shall be provided for each service tapped on PVC pipe.

2.2 DUCTILE IRON PIPE (AWWA C151)

Pipe shall be manufactured and tested in accordance with ANSI A21.51 and shall be designed in accordance with ANSI Specifications A-21-50 method of design using 60,000 psi minimum tensile strength and 42,000 psi minimum yield strength. Pipe shall be designed for a rated working pressure of 350 psi, 2 to 8 ft. cover, Type 2 laying condition.

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

2.3 GALVANIZED STEEL PIPE (Use Only for Connecting to Existing Galvanized Pipe.)

Steel pipe 2 inch and smaller shall be galvanized with screw joints, and shall conform to the requirements of Federal Specifications WW-P-406, Type 1, Class A.

2.4 JOINTS (AWWA C110 AND C111)

Pipe shall be mechanical joint "Fastite", "Belltite", "Tyton", or approved equal per ANSI A21.11. Flanged joints shall be used above ground unless otherwise indicated.

Mechanical joint to be furnished according to ANSI Specifications A21.11 and furnished with complete Mechanical Joint with accessories. The bolts and nuts to be alloy steel (Corten Type such as US Alloy or approved equal). Gaskets to be made of plain rubber with 7-75 durometer.

2.5 FITTINGS (AWWA C110)

Iron to be furnished in accordance with ANSI Specifications A21.10 where applicable with mechanical joints and cement lining as shown above. Unless otherwise specified, cast iron fittings shall be provided. Compact fittings are not acceptable.

2.6 BOLTS AND NUTS

All mechanical joints shall employ high strength corrosion resistant tee head bolts and hexagon nuts. Bolts for restrained joint shall be additional length in accordance with joint manufacturer's requirements. Mechanical joint studs shall be used for tapped bells. All flanged joints shall employ hex head machine bolts, bolt stud, or studs and hexagon nuts of low carbon steel conforming to ASTM A 307 Grade B and AWWA C110 and C115. Higher strength bolts shall not be used with grey cast iron flanges. "All thread" type products shall not be used. When restraining fittings with rods the rods shall be connected to bolts with threaded couplings.

2.7 SERVICE TUBING

2.7.1 Copper Service Tubing: Copper tubing from corporation stop to house service shall be Type K annealed copper. Service tubing shall be joined by the use of flair or compression joints.

2.7.2 The pipe shall be permanently imprinted with manufacturer's brand name, pipe size, commercial standard notation, identification of the National Sanitation Foundation approval, recommended working pressure and production code.

Pipe dimensions and tolerance shall correspond with copper tubing sizes.

2.8 VALVES AND ACCESSORIES

Valves larger than 2 inches shall have bell mechanical joint for below ground installation and be equipped with a 2 inch square operating nut. Above ground valves shall be flanged joint hand wheel operated.

2.8.1 Gate Valve Resilient Seat: Resilient seat gate valves shall be single solid wedge disc type with a replaceable resilient rubber seat ring reinforced with stainless steel. The stem nut shall be integrally cast and the stem shall ride on an antifriction washer. The inside of the valve shall be epoxy coated. The valve shall be certified to provide zero leakage at 250 psi. Valve shall meet AWWA Specification C-509.

2.8.2 Gate Valves 2 Inches and Smaller: Valves shall be all brass or bronze construction, screwed type, with union bonnet, rising stem, suitable for 150 pounds working pressure. Valves shall be Nibco 135 or equal.

2.8.3 Ball Valves (¼-Inch to 2 Inches): Metal ball valves shall have a 2-piece brass body, with stainless steel ball and trim TFE bearing and packing, TFE teflon seats, zinc die cast handle with nickel finish and brass handle nut. Valves shall be similar to Niles James Bury Series 300.

PVC ball valves shall be union type two piece body construction of Type I PVC with CPVC ball and stem, Teflon seats and viton stem seal.

2.8.4 Tapping Valves and Tees: Tapping valves shall meet the requirements of AWWA C-500 gate valves indicated above and be designed for making taps to existing mains under pressure. Valves, tees, and boring equipment used shall be mutually compatible. Tapping tees unless otherwise indicated shall be constructed of cast or ductile iron with non-corrosive accessories.

All stainless steel fabricated tees may be used when indicated or directed by the engineer. All nuts and bolts shall be non-corrosive and be compatible with fitting materials.

2.8.5 Valve Boxes: Cast iron valve boxes shall be provided on all buried valves and shall consist of a bell base covering the operating nut and valve head, an adjustable vertical shaft at least 5¼ inches in diameter and a top section extending to a point even with the finished ground surface, provided with a cast iron cover placed concentrically over the operating nut.

2.9 HYDRANTS

All hydrants shall be dry barrel and installed with adequate crushed stone for drainage. All hydrants shall be restrained with adequately sized thrust blocks. Unless otherwise directed all hydrants shall be additionally restrained by two non-corrosive metal tie rods extending to the main line tee.

2.9.1 Fire Hydrants: All hydrants shall be manufactured in accordance with the current edition of AWWA Standard C-502 and be traffic design with minimum pressure ratings of 175 psig working and 350 psig hydrostatic. The hydrant main valve shall be compression type that closes with the line water pressure. Unless specifically directed, all hydrants shall be 3-way with one 4½-inch pumper nozzle and two (2) 2½ inch hose nozzles. Hose threads shall be National Standard Threads. Hydrant shoes shall be 6 inch mechanical joint with or without restrainer ears as indicated. All hydrants shall receive one primary coat and two finishing coats of paint meeting Fed. Spec. TT-P-362 Type II Class A of the color directed.

Fire hydrants shall be city, county, or authority standard as applicable and meet engineer's approval.

Fire hydrant barrels and shoe shall be constructed of cast iron or ductile iron with a minimum inside barrel diameter of 6 inches. The shoe, lower barrel and upper barrel shall be assembled by bolted flanged connections. All working parts shall be bronze including operating nut, valve seat, and seat retainer.

The seat retainer shall be securely held in place by flanges. A minimum of two (2) or more drains shall be utilized to drain to barrel. Hydrants shall be equipped with automatic self-lubricating system and reservoir that will lubricate the stem threads and bearing surfaces each time the hydrant is operated. The thread bearing surfaces and sleeve shall be enclosed in protective chambers sealed with 0-rings or other suitable sealing system. Lubricant refill shall be accomplished without disassembly of the hydrant.

Fire hydrants shall be Mueller Super Centurion, American B-84B or equal meeting these specifications.

2.9.2 Flushing Hydrants: Flushing hydrants shall be 2 inch lockable, non-freezing self-draining type. All of the working parts shall be of bronze-to-bronze design and be serviceable from above grade with no digging. The outlet shall be bronze and be 2½ inch NST. Hydrants shall be 2½ feet bury and be post type or below ground as indicated. Flushing hydrant shall be similar and equal to Kupferle Model 77 or 78.

2.9.3 Post Hydrants (2 Inch and 3 Inch): Post hydrants shall be 2 inch non-freezing self-draining type. All working parts shall be brass and shall be removable from above ground with no special wrenches. The 3 inch barrel shall be ductile iron with a 2½ inch NST outlet. The inlet connection shall be 2 or 3 inch mechanical joint as indicated. The hydrant shall be equipped with an operating nut, handwheel or tamperproof "T" handle as directed.

2.10 THRUST RESTRAINT

2.10.1 General: Plugs, caps, tees bends deflecting 11¼° or more, and fire hydrants shall be provided with thrust blocking and/or retainer glands or metal tie rods as directed. Valves shall be security anchored or provided with thrust blocking to prevent movement.

2.10.2 Concrete Thrust Blocks: Concrete having a minimum 28 day strength of 2,500 psi shall be placed between the fitting and undisturbed ground. The thrust and bearing sides of the blocks shall be poured directly against the fitting and undisturbed earth. The sides of the blocking not subject to thrust may be poured against form. Blocking shall be placed so that the fitting will be accessible for repair. The minimum area of bearing shall be as shown however actual area of bearing shall be increased to provide sufficient bearing area when low strength soils are encountered.

2.10.3 Retainer Gland: Retainer glands shall be used on ductile iron pipe only and be designed and manufacturer in accordance with DIPRA-01. The gland shall be rated for 350 psig by Underwriters Laboratories. Restraining shall be accomplished by wedge acting lugs tightened by bolts with break-away heads to provide uniform pressure.

2.10.4 Metal Tie Rods: Tie rod joints shall consist of threaded tie rods connected to joints with eye bolts or lugs or lugged fittings. All rods, eyebolts, couplings and nuts shall be ¾-inch high strength ASTM A242-81 (CorTen) corrosion resistant steel. The minimum number of rods used on 4 inch and 6 inch joints shall be two (2), three (3) rods for 8 inch pipe, four (4) for 10 inch pipe and six (6) rods for 12 inch pipes.

2.10.5 Megalug Joint Restraint: Mechanical joint restraint shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Flexibility of the joint shall be maintained after burial. Glands shall be manufactured of ductile iron conforming to ASTM A536-80. Restraining devices shall be of ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI/AWWA A21.11 and ANSI/AWWA C153/A21.53 of latest revision. Twist-off nuts shall be used to insure proper actuating of the restraining devices.

The mechanical joint restraint device shall have a working pressure of at least 250 psi with a minimum of safety factor of 2:1 and shall be EBAA Iron, Inc. MEGALUG or equal.

2.11 SERVICE VALVES AND ACCESSORIES

Note: All materials in this section shall be furnished and installed by the Contractor except for water meters.

All corporation stops, curb stops, backflow preventers and tapping saddles shall be constructed of AWWA Brass (ASTM B62 (85-5-5-5).

2.11.1 Corporation Stops: Corporation stops shall be of AWWA brass construction designed for insertion in cast iron, ductile iron, steel, or PVC water mains under pressure. Threads shall conform with AWWA C-800 Specification in the size indicated in the plans or ¾-inch if not so indicated. Corporation stops shall be ball type and rated for 200 psi working pressure. Corporation stops shall be Mueller B-2500 Series, Ford F100 Series or approved equal.

The outlet end shall be a conductive compression joint for copper or non-metallic service tubing. (Provide rigid metal liner for non-metallic tubing.)

2.11.2 Curb Stops:

2.11.2.1 "O" Ring Type: Curb stops shall be AWWA brass (ASTM B62) constructed with "O" ring port and body seals. The plug shall be easily removable from the top without requiring access to the bottom or utilizing screwed nuts. The outlet shall be inside I.P. thread and the inlet shall be a conductive compression joint for

copper or PVC service tubing. (Provide rigid metal liner for PVC tubing.) The curb stop shall be similar and equal to Mueller H-1500 Series or Ford with locking wing.

2.11.2.2 Ball Type: Ball type curb stops shall be AWWA Brass constructed designed for 300 psig maximum working pressure and conforming with ANSI/AWWA C 800. The ball shall be Teflon coated brass or TTFE coated with nitrile (BUNA N) rubber seals providing leak tight sealing in either direction. The stem shall be a blow out proof design and provide precision alignment in both open and closed position. Stems shall have double "O" ring seals. The stem connection shall be fabricated so that overtorqueing the stem will not damage the remainder of the valve assembly. When specified the stem shall be lockable. The ball type curb stop shall be a Mueller 300 Series or Ford B21 or equal brass.

2.11.2.3 Service Saddles: Service saddles shall be specifically sized for the O.D. of the pipe on which it is installed and be rated at a minimum of 250 psig. The body shall be equipped with a Bun-N rubber "O" ring gasket to produce a water tight seal against the main. The saddle body shall be constructed of AWWA Brass ASTM B62 with stainless steel or silicon bronze accessories. Service saddles for PVC pipe shall be double strap or double wide strap design. Saddles shall be Mueller Series H-1300 or H-1600 series or Ford Model S70 for PVC, S90 for C900, or 200 for ductile pipe.

2.11.2.4 Meter Boxes: The water meter boxes shall be concrete with cast iron lid cover, or cast iron body with cast iron lid, or plastic body with plastic lid. The lid of the meter box shall be marked "Water Meter". The meter box shall be of jumbo size sufficient to house the meter and allow operation of the curb stop. An oversized or additional meter box shall be installed to house accessories including gate valves, pressure reducing valves, and backflow preventers. Unions or insulated unions shall be installed as necessary for removal of accessories and or to prevent electrolis of dissimilar materials. Meter boxes shall be the water suppliers general standard if applicable.

2.12 PRECAST REINFORCED MANHOLES AND BOXES

Reinforced concrete manholes and boxes shall conform to ASTM Specification C-478. Joints for precast sections shall be tongue and groove or "O" ring as indicated in the plans.

2.13 PRESSURE CONTROL VALVES

A. The Pressure Reducing Valve with Check is an automatic control valve designed; 1) to reduce a higher inlet pressure to a lower constant outlet pressure regardless of fluctuating flow rates and/or varying inlet pressure and 2.) to prevent reverse

flow. It is a pilot controlled, hydraulically operated, diaphragm actuated globe valve in the oblique (Y) pattern design. Valve differential pressure powers the diaphragm actuator open or closed. The lower control chamber is connected through a fixed orifice to the downstream pressure, which serves to cushion the closing of the valve. The upper control chamber, which operates on a two-way control principle, has varying pressure produced by the regulating pilot and the pilot's internal upstream restriction needle valve.

The pressure regulating pilot senses downstream pressure and modulates open or closed. This varies the pressure in the upper control chamber causing the main valve to throttle thus maintaining constant delivery pressure. When the downstream pressure falls below the pilot setting the pilot opens, pressure in the upper control chamber decreases and the main valve modulates open to increase downstream pressure and maintain pilot setting. Should the downstream pressure rise above the pilot setting the pilot closes, pressure in the upper chamber increases and the main valve throttles closed to decrease downstream pressure to the pilot setting. Should downstream pressure exceed upstream pressure, the downstream pressure is directed to the upper control chamber where it is trapped by the upstream check valve thus closing the main valve and preventing reverse flow. The pressure reducing pilot has an adjusting screw to preset the desired downstream pressure and an internal needle valve to control the closing speed. For easy identification the pressure reducing pilot is stamped with the number "2" on the side of the pilot body.

B. Main Valve - The main valve shall be a center guided diaphragm actuated globe valve of oblique (Y) pattern design. The body and cover shall be cast iron, ASTM A-126 Class B, with bronze seat. The internal and external surfaces of the valve body shall be fusion bonded coated. End connections shall meet the ANSI, ISO, DIN, JIS or other internationally recognized standard required. The body shall have a replaceable non-threaded seat ring that is held in place by set screws which tighten into a body groove. This seat should be accessible and serviceable without removing the valve from the pipeline. The seat area shall have a flow opening with no stem guides, bearings or supporting ribs.

C. Actuator - The actuator assembly shall be a double chamber design with a separating partition between the lower surface of the diaphragm and the main valve. The entire actuator assembly consisting of the seal disk, valve shaft, bearing, diaphragm assembly, separating partition and top cover must be removable from the valve as a single unit. The control chamber between the diaphragm and the separating partition shall be capable of being open to or isolated from the valve internal body pressure. The stainless steel valve shaft shall be guided throughout its travel by a bearing in the separating partition. The replaceable resilient seal shall be rectangular in cross section and contained on three and one half sides. A lip shall be provided on the seal disc outside edge to

lock the seal in place. The actuator assembly must be capable of accepting a V-port throttling plug by simply bolting the device to the seal disk.

D. Control System - The control pilot shall be direct acting, adjustable, spring loaded diaphragm actuated valve with a built-in needle valve to adjust the main valve closing speed. The body and cover shall be of brass or bronze construction with stainless steel trim and resilient seal. Liquid to the pilot must be filtered and cock valves must be provided to isolate the control loop.

E. Quality Assurance - The main valve, pilot, control tubing, filter and isolation valves shall be factory assembled and tested. The valve manufacturer must be completely certified to the ISO 9002 Quality Assurance Standard. Valve shall be manufactured by Bermad, Model No. 720, or equal.

F. By-Pass Line and Vault - Contractor shall also include in his price for the pressure control valves all necessary piping and values for the by-pass line and a precast concrete vault with aluminum access hatch as shown in the plans.

2.14 BACKFLOW PREVENTERS 2 INCHES AND LARGER REDUCED PRESSURE PRINCIPLE

Reduced Pressure Principle Backflow Preventers 2 inches to 10 inches shall be in accordance with ASSE 1013. The backflow preventer shall be a complete assembly consisting of two independently acting springloaded toggle lever check valves together with an automatically operating pressure differential relief valve located between the two check valves. The first check valve shall reduce the supply pressure a predetermined amount so that during normal flow and the cessation of normal flow, the pressure between the checks is less than the supply pressure. In the case of leakage of either check valve, the differential relief valve shall discharge to atmosphere to maintain the pressure between the checks, less than the supply pressure.

This unit shall include tightly closing shutoff valves located at each end of the device, and shall be fitted with properly located test clocks. Operation shall be completely automatic. All internal parts of the toggle lever check valves and pressure differential relief valve must be removable or replaceable without removal of the preventer from the line. The total head loss through the complete backflow assembly shall not exceed 10 psi at pipe velocities of 14 fps. The backflow preventer shall be similar and equal to Clayton RP-1.

2.15 CHECK VALVES, SILENT TYPE

Silent type check valves shall be a single disc type with a semi-steel body, bronze trim and a stainless steel spring. The flow area shall be approximately 10% greater than the pipe size. The valve shall be designed to open at ¼ to ½ PSI and close completely while

there is still a positive head on the discharge side at approximately ½ PSI. The valve shall be as manufactured by APCO (600 Series), Val-Matic or approved equal.

2.16 AIR RELEASE VALVE

Air release valves shall be designed for releasing entrained air in lines under pressure utilizing a compound lever design. The valve body shall be cast iron and the float shall be stainless steel. Seats shall be BUNA-N and linkage levers shall be bronze or detrin. All other internal parts shall be stainless steel or bronze. All valves shall be mounted with a gate or ball valve to permit easy servicing. Air release valves shall be as manufactured by APCO, Crispen or Val-Matic.

2.17 PRESSURE GAGES

Pressure gages shall be a 4½ inch industrial grade gage, temperature compensated with a 1% full scale accuracy. The tube shall be constructed of phosphor bronze and the socket shall be brass. Connection shall be made by ¼-inch NPT male fitting. The gage shall have a 0-200 psi range with scales for 1-200 psi unless otherwise indicated. A snubber shall be furnished to provide steady state pressure readings and a brass and/or stainless steel ball valve shall be installed at the mainline connection.

PART 3 - EXECUTION

3.1 PREPARATION

3.1.1 General: The Contractor shall layout and mark construction routes in accordance with the plans and specifications in advance of the construction. No deviations shall be made from line grade and location shall be made except as directed by the Engineer. All materials for each run of pipe or service installation shall be on hand prior to beginning excavation.

3.1.2 Sub-Surface Explorations: Whenever necessary to determine the location of the existing pipes, valves or other underground structures, the Contractor shall examine all available records and shall make all explorations and excavations for such purpose. Where existing mains are to be tied into, the Contractor shall excavate and examine the tie-in locations prior to ordering any valves or fittings for the tie-in. No additional compensation will be allowed for conditions different from shown on the plans, but the Contractor will be paid according to the unit price bid for materials actually required in the tie-in.

3.1.3 Barricades, Guards, and Safety Provisions: To protect persons from injury, and to avoid property damage, adequate barricades, construction signs, torches, red lanterns and guards as required shall be placed and maintained during the progress of the construction

work and until it is safe for traffic to use the trenched highways. Rules and regulations of the local, state, and federal authorities respecting safety provisions shall be observed.

3.1.4 Traffic and Utility Controls: Excavation for pipe laying operations shall be conducted in a manner to cause the least interruption to traffic. Where traffic must cross open trenches, the Contractor shall provide suitable bridges at street intersections and driveways. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire or police call boxes, or other utility controls shall be left unobstructed and accessible during the construction period.

3.1.5 Interruption of Water Service: No valve or other control on the existing system shall be operated for any purposes by the Contractor without approval of the Engineer, and all consumers affected by such operation shall be notified by the Contractor at least one hour before the operation and advised of the probable time when the service will be restored. In all cases all interrupted services will be restored before the end of the working day.

3.1.6 Property Protection: Trees, fences, poles and all other property shall be protected unless their removal is authorized; and any property damaged shall be satisfactorily restored by the Contractor.

3.1.7 Railroad and Highway Crossing: When any railroad or highway is crossed, all precautionary construction measures required by the railroad and highway officials shall be followed.

3.1.8 Protection Underground and Surface Structures: Temporary support, adequate protection and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the process of the work shall be furnished by the Contractor at his own expense.

3.1.9 Flow of Drains and Sewers Maintained: Adequate provisions shall be made for the flow of sewers, drains, and water courses encountered during construction, and the structures which may have been disturbed shall be satisfactorily restored upon completion of the work. All sanitary sewer services will be restored to operation before the end of the work day.

3.2 EXCAVATION AND PREPARATION OF TRENCH

3.2.1 Description: The trench shall be excavated to the alignment and depth required and only so far in advance of pipe laying as the Engineer shall permit. The trench shall be so braced and drained that workmen may work therein safely and efficiently. It is essential that the discharge from pumps lead to natural drainage channels, to drains, or to storm sewers. All excavations shall be in accordance with OSHA and any state or local safety requirements. The Contractor shall be responsible for insuring that these requirements are adhered to.

3.2.2 Width: The trench width may vary with and depend upon the depth of trench and the nature of the excavated material encountered, but in any case shall be of ample width to permit the pipe to be laid and jointed properly and the backfill to be placed and compacted properly. The minimum width of unsheeted trench shall be 18 inches, and for pipe 10 inches or larger, at least one foot greater than the nominal diameter of the pipe.

3.2.3 Pipe Foundation in Good Soil: The trench, unless otherwise specified, shall have a flat bottom, conforming to the grade to which the pipe is to be laid. The pipe shall be laid upon sound soil cut true and even so that the barrel of the pipe will have a bearing for its full length.

3.2.4 Correcting Faulty Grade: Any part of the trench excavated below grade shall be corrected with approved material, thoroughly compacted.

3.2.5 Removal of Debris: When excavation of rock, pieces of concrete or masonry or other debris or subterranean structures are encountered, all rock or debris shall be removed to provide a clearance of at least 6 inches below and on each side of all pipe, valves, or fittings. When excavation is completed, a bed of sand, crushed stone, or earth that is free from stones or large clods shall be placed on the bottom of the trench to the previously mentioned depths, leveled, and tamped.

3.2.6 Bell Holes Required: Bell holes of ample dimensions shall be dug in each trenches at each joint to permit the jointing to be properly made.

3.2.7 Braced and Sheeted Trenches: Wherever necessary to prevent caving, excavations in sand, gravel, sandy soil or other unstable material shall be adequately sheeted and braced. Where sheeting and bracing are used, the trench width shall be increased accordingly. Trench sheeting shall remain in place until the pipe has been laid, tested for defects, and repaired if necessary, and the earth around it compacted to a depth of 2 feet over the top of the pipe.

3.2.8 Care of Surface Material for Re-Use: If local conditions permit their reuse, all surface materials suitable for reuse in restoring the surface shall be kept separate from the general excavation material.

3.2.9 Manner of Piling Excavated Material: All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalk and driveways. Gutters shall be kept clear or other satisfactory provisions made for street drainage. Also storm drains shall be kept clear.

3.2.10 Trenching by Machine or by Hand: The use of trench-digging machinery will be permitted except in places where operations of same will cause damage to trees, buildings or existing structures above or below ground; in which case hand methods shall be employed.

3.2.10.1 Removing Pavement: The Contractor shall remove pavement as necessary for installing the new pipe line and appurtenances and for making connections to existing pipe lines. Pavement shall be cut back from the top edges of ditch lines for a distance of at least nine inches on each side of the ditch to allow for solid bearing edges for pavement to be replaced.

3.2.10.2 Marking: Before removing any pavement, the pavement shall be marked for cuts neatly paralleling pipe lines and existing street lines. Asphalt pavement shall be broken along the marked cuts by use of jack hammer or other suitable tool. Concrete pavement shall be scored to a depth of approximately 1½ inches along the marked cuts. Scoring shall be done by use of a rotary saw, after which the pavement may be broken below the scoring by use of jack hammer or other suitable tool.

3.2.10.3 Machine Pulling: No pavement shall be machine pulled until completely broken and separated along the marked cuts.

3.2.10.4 Damage to Adjacent Pavement: The pavement adjacent to pipe line trenches must not be disturbed or damaged due to any cause such as caving ditch banks, indiscriminate use of construction machinery, etc. The Contractor shall remove the damaged pavement and shall replace at his own expense.

3.2.10.5 Remove and Replace Pavement: Pavement shall be destroyed only to the minimum width of trench as stated under specifications on excavation and restoration of pavement, but if damaged beyond these limits shall be replaced at the expense of the Contractor.

3.3 PIPE LAYING

3.3.1 General: All pipe shall be laid and maintained to the required lines and grades; with fittings, valves and hydrants at the required locations; and with joints centered and spigots homed; and with all valve and hydrant stems plumb.

3.3.2 Depth of Pipe Cover: All pipe shall be laid to the depth shown or described, measured from the established street grade or the surface of the permanent improvement to the top of the barrels of the pipe.

Unless otherwise shown the nominal cover for pipe under or along paved roads will be 30 inches. The nominal cover for pipe under or along unpaved streets will be 40 inches. At paved streets, intersections or where the new pipe lines cross existing underground lines at the approximated same depth as the new line, the cover shall be increased and the new line laid below existing line or structures. Where the existing line or structures are of sufficient depth that the new lines when laid will have 6 inches of separating earth between them and other pipe or structure and 24 inches of cover, the new lines may be

laid above the existing lines when authorized by the Engineer. No extra payment will be allowed for extra depth laying of pipe where necessary to clear existing lines, pipes or structures. The nominal cover along US or State Roads and under ditch sections is 40 inches.

3.3.3 Permissible Deflection at Joints: Wherever necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions, the plumb stem, or where long radius curves are permitted, the degree of deflection shall be approved by the Engineer. In no case shall the manufacturers published maximum degree of deflection be exceeded.

3.3.4 Manner of Handling Pipe and Accessories into Trench: 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, valves, and hydrants shall be carefully lowered into the trench, piece by piece, by means of a derrick, ropes, or other suitable tools and equipment, in such manner as to prevent damage to pipe or pipe coating. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.

3.3.5 Inspection of Pipe: Before lowering and while suspended, the pipe shall be inspected for defects and rung with a light hammer to detect cracks. Any defective, damaged or unsound pipe shall be rejected.

3.3.6 Pipe Kept Clean: All foreign matter or dirt shall be removed from the inside before it is lowered into its position in the trench, and it shall be kept clean by approved means during and after laying.

3.3.7 Bell Ends to Face Direction of Laying: Unless otherwise directed, pipe shall be laid with bell end facing in the direction of the laying; and for lines on an appreciable slope, bells shall at the discretion of the Engineer, face upgrade.

3.3.8 Laying the Pipe: The spigot shall be centered in the bell, the pipe shoved into position, and brought into the alignment; it shall be secured there with earth carefully tamped under and on each side of it, excepting at the bell holes. Care shall be taken to prevent dirt from entering the joint space.

3.3.9 Unsuitable Conditions for Laying Pipe: No pipe shall be laid in water, or when the trench conditions or weather is unsuitable for such work.

3.3.10 Preventing Trench Water from Entering Pipe: At time when pipe laying is not in progress, the open ends of pipe shall be plugged by approved means, and no trench water shall be permitted to enter the pipe.

3.3.11 Cutting Pipe: Cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe.

3.4 JOINTING PIPE

3.4.1 Mechanical Joints and Push On Joints: Shall be installed in strict accordance with the recommendations of the joint manufacturer and Section 3.4 of AWWA Specifications C600.

3.5 SETTING VALVES, VALVE BOXES, FITTINGS, AND BLOW OFFS

3.5.1 Examination of Material: Prior to installation, valves shall be inspected for direction of opening, freedom of operation, tightness of pressure-containing bolting, cleanliness of valve ports and surfaces, handling damage and cracks.

3.5.2 General: Gate valves and pipe fittings shall be set and jointed to new pipe in the manner heretofore specified for cleaning, laying, and jointing pipe.

3.5.3 Valve Boxes: Cast iron valve boxes shall be firmly supported and maintained centered and plumb over the wrench nut of the gate valve, with box cover flush with the surface of the finished pavement or at such other level as may be directed. Unless otherwise directed, valve boxes set in unpaved areas shall be equipped with a 2' x 2'foot by 6 inch poured in place concrete slab reinforced with 6 x 6 x w1.4/w1.4 wwm. The top of slab shall be flush with finished grade and base shall be placed on a well compacted subgrade.

3.5.4 Back Siphonage to be Prevented: Drainage branches or blow offs shall not be connected to any sewer or submerged in any stream or be installed in any other manner that will permit back siphonage into the distribution system.

3.6 SETTING HYDRANTS

3.6.1 General Location: Hydrants shall be located in a manner to provide complete accessibility, and such manner that the possibility damage from vehicles or injury to pedestrians will be minimized.

3.6.2 Position of Nozzles: All hydrants shall stand plumb, and shall conform to the established grade, with nozzles at least 12 inches above the ground and parallel to or at right angles to the curb with the pumper nozzle facing the curb except that hydrants have two (2) hose nozzles 90° apart shall be set with each nozzle facing the curb at the angle of 45°.

3.6.3 Connection to Main: Each hydrant shall be connected to main pipe with a 6-inch ductile iron branch.

3.6.4 Drainage at Hydrant: A drainage pit 2 feet in diameter and 2 feet deep shall be excavated below each hydrant and filled compactly with coarse gravel or broken stone mixed with course sand, under and around the bowl of the hydrant and to a level 6 inches above the waste opening. No hydrant drainage pit shall be connected to a sewer.

3.6.5 Anchorage for Hydrant: The bowl of each hydrant shall be well braced against undisturbed soil at the end of the trench with concrete blocking and it shall be tied to the with metal tie rods. In no case shall the waste opening be obstructed from free drainage.

3.6.6 Cleaning: Hydrants shall be thoroughly cleaned of dirt or foreign matter before setting.

3.7 PLUGGING DEAD ENDS

Standard plugs shall be inserted into the bells of all dead ends of pipes, tees, or crosses, and spigot ends shall be capped. Plugs or caps shall be jointed to the pipe or fittings in the appropriate manner.

3.8 WET CONNECTIONS

Where existing wet lines are to be tied on to new mains directed by the Engineer, the Contractor shall make necessary wet connections. This work shall be done to cause the least inconvenience.

3.9 HOUSE SERVICES

After the distribution mains have been laid, tested, and chlorinated as hereinbefore specified, all house services shall be installed as directed by the Engineer. All corporation stops and service lines that are not connected to other pipes and meters shall have the ends plugged in an approved manner to prevent water and dirt from entering the fitting or pipe.

The Contractor shall jet the service lines under all paved areas where possible.

Services shall include corporation and curb stop(s) for each service installed, including tapping to the main and necessary saddles therefore.

Meter boxes shall be furnished and installed as indicated in the plans and specifications.

3.9.1 Service Conversions

Service conversions shall include the connection of existing service tubing to the new service tubing. No new meters, meter boxes, etc. will be required to complete this item of work. The service tubing required to make the service conversion will be paid for by the linear foot under water service tubing. The new mains shall be tested and approved for use prior to completing this item of work.

3.10 BACKFILL

3.10.1 Backfilling: Backfill material shall be free from refuse, vegetable or organic material, broken pavement, rocks or boulders and shall be deposited in the trench simultaneously on both sides of the pipe for the full width of the trench in 4 inch layers to an elevation of at least 6 inches above the top of the barrels of the pipe, leaving the joints exposed for examination during the pressure test as previously specified. Material shall be dry enough to compact to the equivalent density of the surrounding earth. If too dry, the backfill material shall be dampened.

Backfill shall be in 4 inch layers, tamped with hand tamps, to 8 inches above the top of the pipe. The remainder of the trench shall be backfilled in 6 inch layers and tamped with a mechanical tamp unless otherwise authorized by the Engineer.

3.10.2 Deficiency of Backfill, by Whom Supplied: Any deficiency in the quantity of material for backfilling the trenches, or for filling depressions caused by settlement, shall be supplied by the Contractor at no cost to the Owner.

3.11 REPAVING

Any paved streets cut by these operations shall be repaved in a workmanlike manner and restored to their original conditions as shown or specified. The paving shall be of material equal to that removed and shall be laid in accordance with the specification covering the type of paving. Where paved streets are cut, shell or gravel shall be provided immediately following backfill, and such crossing shall be maintained until repaved. The cost of furnishing the shell or gravel and maintaining the ditches shall be borne by the Contractor and included in the price bid for laying pipe.

When flexible pavement is replaced, a 6 inch sand-clay base be placed for the top width of the trench 1½ inches below the finish grade of the existing pavement. After the base has been compacted, the remaining 1½ inches shall be paced with a bituminous mix of the same type as that removed. Prior to placing the bituminous pavement, the 6 inch sand-clay base shall receive a tack coat of 0.05 gallons per squared yard of cut back asphalt. Where concrete or other type of pavement are removed they shall be replaced with the same type and thickness as that removed. Just prior to repaving, edges shall be squared and cut to a string line so that the patch will present a neat appearance.

3.12 REPLACEMENT OF CONCRETE DRIVEWAYS AND SIDEWALKS

All concrete sidewalk and concrete driveways shall be constructed of Class "A", Type 2, 3,000 psi concrete, mixed, transported, placed and cured in accordance with Section 501 of the Alabama Highway Department Standard Specifications, 1981 Edition. Old concrete shall be cut to a neat line. The base material on which the concrete is placed shall be prepared so that the base is firm and free from any spongy materials. Form work

shall be true and new concrete surfaces shall conform as nearly as possible to the old materials replaced. All flat concrete shall be the same thickness as the old concrete replaced, but in no case less than 4" thick in sidewalks and 6" at driveways. Welded wire fabric (6 x 6 - #10/10) shall be installed at mid-depth of all concrete.

3.13 CLEAN-UP

Where these operations are on City or County or private property, the job shall be kept clean at all times. Loose dirt shall not be allowed to clog ditches or cover sidewalks. Soft clay or other undesirable material removed from the trenches shall be removed from the streets, sidewalks, or ditches. The Engineer reserves the right to demand that the Contractor's forces be diverted to this clean-up at any time the Engineer rules that condition of streets, sidewalks, or private property warrants such diversion.

3.14 MAINTENANCE OF SURFACES

Following the certification of completion by the Engineer, the Contractor shall maintain the surface of the unpaved trenches, adjacent curbs, sidewalks, gutters, shrubbery, fences, sod, and other surfaces disturbed for a period of 3 months thereafter, and shall maintain the repaved areas (if paved by the Contractor) and adjacent curbs, gutters and sidewalks for one year after said certifications. All material and labor required for the maintenance of the trenches and adjacent structures shall be supplied by the Contractor and the work shall be done in a manner satisfactory to the Engineer.

3.15 UNDERCROSSING OF CONSTRUCTED HIGHWAYS AND RAILROADS

3.15.1 General: At locations shown on the plans the Contractor shall construct an undercrossing by one of the methods specified below to provide a structure for utilities or traffic that shall not create a hazard, produce interruption of traffic or require additional maintenance by Highway Department or Railroad Company.

The contractor shall secure all necessary permits, easements, right-of-ways, and post whatever security bonds as may be required by the Highway Department or Railroad at no additional cost to the Owner.

The Contractor shall provide a scaled drawing showing proposed location dimensions of casing, type and method of installation for approval prior to initiating work. Access pits, lead and tail ditches shall be protected by sheeting and bracing as required to provide safe working conditions during progress of job. Replacement of excavation and grassing shall be at no cost to the State Highway Department or Railroads and to standards to original roadway construction.

Public liability and property damage shall be required of the Contractor at limits approved by the Highway Department or Railroad.

For railroad and highway undercrossings, all materials, methods, limits and depths of construction shall be in accordance with the State Highway Department Specifications and no less than the following minimums: Limits of casing installation shall be not less than 2 feet outside the shoulder line unless specifically approved.

Minimum cover over casing pipe shall be not less than 2 feet, except the sizes 30 inches and larger shall require not less than one diameter of cover. Minimum pipe wall thickness shall be as follows:

8⅝"	Outside Diameter -	0.188"
10¾"	Outside Diameter -	0.188"
12¾"	Outside Diameter -	0.188"
16"	Outside Diameter -	0.219"
18	Outside Diameter -	0.250"
20"	Outside Diameter -	0.281"
24"	Outside Diameter -	0.344"
30"	Outside Diameter -	0.406"
36"	Outside Diameter -	0.469"

For jacking method the minimum pipe walls for smooth steel pipe shall be as above. Corrugated steel (metal) pipe shall be minimum of No. 10 gauge, galvanized and fully asphalt coated and concrete pipe shall be tongue and groove type, Class IV minimum.

3.15.2 Boring Method: Smooth wall new steel pipe meeting the required material standards shall be installed with suitable equipment providing a mechanically augered bore followed immediately by the casing pipe, without the use of water at any time during the work, to produce firm and continuous contact with the unremoved earth in the highway subgrade or fill.

3.15.3 Jacking Method: Casing pipe installed by excavation from within the pipe while the pipe advances into excavated areas shall be guided by a jacking frame and rails to maintain line and grade. Not more than 6 inches excavation ahead of the casing pipe will be allowed during installation. Voids outside the jacked casing shall be filled with pumped cement grout, applied at a pressure of not less than 40 psi where an annular space between the casing and earth is established.

3.16 HYDROSTATIC TESTS

3.16.1 Pressure During Test: After the pipe has been laid and partially backfilled as specified, all newly laid pipe, or any valved section of it, shall, unless otherwise specified, be subjected to hydrostatic pressure of 150% of the working pressure not to exceed maximum pressure ratings of pipe. Test pressure shall not vary by more than plus or minus 5 psi. Test pressures shall not be less than 150 psi. The Contractor shall furnish and install a pressure recorder such that each test can be recorded. The recorder shall be

capable of recording up to 200 pounds of pressure on a 24-hour chart. The original chart recording shall be turned in to the Engineer and shall include the date of test, time of test, and line segment tested.

3.16.2 Duration of Pressure Test: The duration of each pressure test for exposed pipe and fittings shall be at least 2 hours or until the line has been completely inspected for visible leaks. The duration of each pressure test for partially backfilled pipelines shall be at least six (6) hours in duration.

3.16.3 Procedure: Each section of pipe shall be slowly filled with water and the specified test pressure, measured at the lowest point of elevation, shall be applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, gauges and all necessary apparatus shall be furnished by the Contractor.

3.16.4 Expelling Air Before Test: Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at joints or at highest elevations, and afterwards tightly plugged.

3.16.5 Permissible Leakage: Suitable means shall be provided by the Contractor for determining the quantity of water lost by leakage. No pipe installation will be accepted until or unless this leakage (evaluated on a pressure basis of 150 psi) is less than 10 U. S. Gallons per 24 hours per mile of pipe per inch nominal diameter. All visible leaks are to be repaired regardless of quantity.

3.16.6 Variation from Permissible Leakage: Should any test of combined sections of pipe laid disclosed leakage per mile of pipe greater than that specified, or if individual sections show leakage greater then the specified limit, the Contractor shall, at his own expense, locate and repair the defective joints until the leakage is within the specified allowance.

3.16.7 Leakage Defined: Leakage is defined as the quantity of water to be 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.

3.16.8 Time for Making Test: Pipe may be subjected to hydrostatic pressure, inspected, and tested for leakage at any convenient time after the lines are installed and when weather and site conditions are such that an adequate observation of the test can be made. The Contractor shall notify the Engineer and Owner at least 24 hours before testing is scheduled. Testing is to be witnessed by the Engineer.

The Contractor shall pressure test and chlorinate sections of pipe as they are completed.

The Engineer reserves the right to require pressure tests and chlorination at any stage of construction. Failure of the Contractor to satisfactorily complete these tests as requested

by the Engineer shall be grounds for stopping these phases of construction until the testing is completed.

3.17 CHLORINATION OF COMPLETED PIPE LINE

Before placing into service all new water distribution systems, or extensions to existing systems, or any valved section of such extension or any replacement in the existing water distribution system shall be chlorinated.

Any of the following methods of procedure shall be followed, subject to the approval of the Engineer.

Liquid Chlorine gas-water mixture
Direct Chlorine feed
Calcium Hypochlorite and water mixture

3.17.1 Preliminary Flushing: Prior to chlorination, all dirt and foreign matter shall be removed by a thorough flushing through the hydrants, or by other approved means. Each valved section of newly laid pipe shall be flushed independently. This shall be done after the pressure test is completed. All water mains shall be flushed at a velocity greater than or equal to 2.5 feet per second.

3.17.2 Liquid Chlorine: A chlorine gas-water mixture shall be applied by means of a solution-fed chlorinating device, or if approved by the Engineer, the gas shall be fed directly from a chlorine cylinder equipped with a proper device for regulating the rate of flow and effective diffusion of gas within the pipe. (Chlorination with the gas-waster mixture is preferred to direct feed).

3.17.3 Point of Application: The preferable point of application of the chlorination agent shall at the beginning of the pipe line extension, or any valved section of it, and through a corporation stop inserted in the horizontal axis of the newly laid pipe. The water injector for delivering the gas-water mixture into the pipe shall be supplied from a tap on the pressure side of the gate valve controlling the flow into the pipe line extension. In a new system, application may be at the pumping station, or the elevated tank, or the standpipe, or reservoir if available. If a supply of water is not available, the Contractor shall haul the water by tank or other approved means. All water used for testing of chlorinating shall be approved by the Engineer. No additional payment will be made to the Contractor for hauling water.

3.17.4 Rate of Application: Water from the existing distribution system or other source of supply shall be controlled to flow very slowly into the newly laid pipe line during the application of chlorine. The rate of chlorine gas-water mixture flow shall be in such proportions to the rate of water entering the pipe that the chlorine dose applied to the water entering the newly laid pipe shall exceed 50 PPM.

3.17.5 Back Pressure Prevented: Back pressure, causing a reversal of flow in the pipe being treated, shall be prevented.

3.17.6 Retention Period: Treated water shall be retained in the pipe long enough to destroy all non-spore-forming bacterial. This period shall be at least 24 hours and preferably longer as may be directed. After the chlorine treated water has been retained for the required time, the chlorine residual at pipe extremities and at other representative points shall be at least 25 PPM.

3.17.7 Chlorination Valves and Hydrants: In the process of chlorinating newly laid water pipe, all valves or other appurtenances shall be operated while the pipeline is filled with the chlorinating agent.

3.17.8 Final Flushing and Test: Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipe line at its extremities until the replacement water throughout its length shall, upon test, both chemically and bacteriologically, be proved to have zero coliform growth and approved by the Public Health Authority having jurisdiction. Certified test reports of chemical and bacteriological analysis shall be provided to the Engineer and proper authorities of the Owner. A water sample shall be collected and tested for each ____ feet of pipeline installed under this contract.

3.17.9 Repetition of Procedure: Should the initial treatment, in the opinion of the Engineer, prove ineffective, the chlorination procedure shall be repeated until confirmed test show that water sampled from the newly laid pipe conforms to the requirements of CHLORINATION OF COMPLETED PIPE LINE, (I).

3.17.10 Alternate Chlorination:

3.17.10.1 Calcium Hypochlorite: On approval of the Engineer, a mixture of calcium hypochlorite ("HTH", "Perchloron", and "Mexochlor") of known chlorine content and water may be substituted as an alternative for liquid chlorine.

3.17.10.2 Proportions of Calcium Hypochlorite and Water Mixtures: A 5% of powder to 95% of water by weight.

3.17.10.3 Application: This calcium hypochlorite and water mixture, first made into a paste and then thinned to a slurry, shall be injected or pumped into the newly laid pipe under conditions heretofore specified for liquid chlorine application, after preliminary flushing.

3.17.10.4 Approval: Provisions for final flushing, testing, and approval under this alternative shall be the same as those described above.

3.17.11 Procedure When Cutting into Existing Pipe Lines: Unless the Engineer shall direct otherwise, cuts made in existing pipe lines for the insertion of valves, fittings, repairs, or for any other purpose shall be chlorinated by shaking a quantity of the powder, predetermined by the Engineer, into the pipe on each side of the cut-in. After slowly filling the section and reversing the flow, the chlorinated water shall be retained for several hours, then flushed until no odor of chlorine can be detected in the waste water, or preferable until a check shall have been made for residual chlorine as provided for herein.

3.17.12 Resumption of Service: After satisfactory chlorination by any of these alternative procedures, the consumers may be served from the newly laid pipe line or the services may be resumed on existing pipe lines upon obtaining approval from State Health Department.

END OF SECTION 02713.