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SPECIFICATIONS - DETAILED PROVISIONS
Section 02718 - Installation of Water Pipeline

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**SECTION 02718
INSTALLATION OF WATER PIPELINE**

PART 1 - GENERAL

1.01 DESCRIPTION

Under these specifications, the Contractor shall furnish all labor, material, equipment and tools required for the complete installation and testing of pipe and pipeline appurtenances and allied structures as stated on the Bidding Sheets, shown on the contract drawings or specified herein, and all within the contract time. The Contractor shall be responsible for all work specified herein and the orderly progress and completion of the work in accordance with an approved schedule of construction.

The work includes, but is not limited to, all excavation, backfill, disposal, resurfacing of roads and driveways, verification of utilities, installation of all pipe and pipeline fittings/specials such as crosses, tees, elbows, bends, joint restrainers, couplings, tapers, butt straps and all necessary cuts and welds. All anchorage for pipe, such as at the ends of lines, at crosses, tees, elbows, bends, etc., shall be sufficient to withstand all unbalanced forces. Unless otherwise approved by the Engineer, anchorage shall be provided by means of double pass, full welds of all steel pipe joints, restraint fittings for plastic (PVC) pipe, or ductile iron pipe, as required by the Contract Drawings and these specifications. The use of concrete anchorage in lieu of restrained joints will be considered on a case by case basis. All welding and restraint shall be included in the bid price for the installation of pipe.

It shall be the responsibility of the Contractor to furnish the District with accurate tie dimensions to all valves installed in the course of constructing this project.

Refer to Section 02201 of the District's standard specifications for requirements relating to Construction Methods and Earthwork.

1.02 QUALITY ASSURANCE

Contractor shall be responsible for the quality of all work of his forces and that of his subcontractors, for adherence to all laws and regulations, and for all public relations regarding the contract work, as set forth elsewhere in the Contract Documents.

1.03 SUBMITTALS

Shop drawings for all pipe and appurtenances shall be submitted pursuant to the requirements of the Contract Documents for Submittals, and shall show the materials, dimensions, stations and all relevant details.

1.04 PRODUCT DELIVERY

- A. Materials Furnished by the Contractor. Except as otherwise stated on the Bidding Sheet, all materials, including water pipe and appurtenances and service connections and appurtenances, shall be furnished in place by the Contractor, excepting service connection meters will not be furnished or installed by the Contractor. Materials to be furnished by the Contractor shall include that necessary for replacement of all obstructions, road surfacing, etc.

The Contractor shall furnish the Engineer, as soon as issued, duplicate copies of all orders placed outside the Contractor's plant for articles or materials to be furnished by the Contractor for incorporation in the work. The Contractor shall also furnish the Engineer with such additional information as reasonably may be required respecting the character of the material and progress of their procurement.

- B. Materials Furnished by the District. ONLY WHERE SHOWN ON THE CONTRACT DRAWINGS OR ON THE BIDDING SHEETS, OR ORDERED BY THE ENGINEER, the District will furnish any or all of the following materials necessary for the completion of the work under these specifications:

1. Cement mortar lined pipe, asbestos-cement pipe, ductile iron pipe, or PVC pipe with rubber gasket joints and gasket rings. Pipe will be delivered to the job site by the Pipe Supplier. Pipe to be unloaded and strung along trench site by Installation Contractor. Approximately 5% of each size of pipe will be furnished in the standard short lengths manufactured by the pipe supplier, except as otherwise requested by the Contractor.
2. Valves, flanges, gaskets, valve risers and caps, bolts, crosses, tees, bends, elbows, tapers, fire hydrant assemblies complete with valve and pipe, or air valve assemblies complete with piping and valves, etc.
3. Joint materials except for cement mortar.
4. Locating wire required for asbestos-cement pipe and PVC pipe systems.
5. Telemetry wire where noted on the construction drawings.

The Contractor shall, within seven (7) days after execution of the contract, meet with the Engineer for approval of his proposed schedule of construction and shall furnish the Engineer a written statement of the Contractor's requirements for delivery of materials and equipment to be furnished by the District with the dates upon which delivery of each class of said materials and equipment will be necessary in order to conform to the Contractor's program of construction.

Materials to be furnished by the District, except for pipe, will be delivered to the Contractor f.o.b. the Contractor's trucks at the District yard or warehouse, and the Contractor will sign for these materials received. No direct payment will be made to the Contractor for hauling or handling materials or equipment furnished by the District, but payment for such handling and hauling will be included in the prices named for the contract items wherein the materials and equipment are used. The Contractor shall be responsible for coordinating the delivery and the actual placement of all pipe in accordance with his requirements and construction schedule, shall properly barricade the pipe and other materials, and shall be responsible for any damage to property as a result of the unloading or placement of the pipe or other materials.

If the delivery of any materials or equipment specified herein to be furnished by the District shall be delayed by strikes, acts of God, or other causes beyond the control or without the fault or negligence of the District, the Contractor shall have no claim against the District for such delay in delivery, but shall be entitled to so much additional time wherein to perform and complete the contract on his part as the Engineer shall certify in writing to be just.

- C. Hauling and Handling Pipe. The Contractor shall protect all pipe from damage during hauling and handling. Dropping or bumping of pipe will not be permitted. Pipe will be handled with a two point pick-up with a six foot minimum spread. Slings or padded cable will be used so as not to damage exterior coating.

Pipe shall not be strung prior to blasting in those areas where blasting is required. Damaged pipe shall be replaced or repaired by the Contractor at his expense, and subject to approval by the Engineer.

1.05 JOB CONDITIONS

Water Furnished by District. The District will make water available for construction at the locations stated in the Special Provisions.

1.06 PAYMENT

- A. Measurement for Payment. Quantities for installation of pipelines and appurtenances on District-administered projects shall be measured for payment as specified herein and described on the Bidding Sheet:
1. Pipelines. Will be measured in place along the horizontal axis of the pipe by the linear foot, on the basis of pipeline completely installed and tested including earthwork, special bedding included in the work, pipe, gaskets, fittings, polyethylene encasement, specials, welding, concrete and miscellaneous materials. The measurement will be continuous through all valves and fittings.

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2. Valves. Will be measured on the basis of each gate valve or butterfly valve completely installed and tested including valve, valve riser and cap, earthwork and miscellaneous materials.
3. Air Valves. Will be measured on the basis of each air valve assembly completely installed and tested including tap-to main, piping, all valves, fittings, valve box, earthwork, and miscellaneous materials.
4. Fire Hydrants. Will be measured on the basis of each fire hydrant assembly completely installed and tested including tap-to-main, piping, valve, valve riser and cap, fittings, hydrant, earthwork and miscellaneous materials.
5. Blow-offs. Will be measured on the basis of each blow-off assembly completely installed and tested including tap-to-main, piping, valve, valve riser and cap, fittings, earthwork and miscellaneous materials.
6. Special Bedding. Will be measured on the basis of the cubic yards of special bedding required to bring the bedding up to grade for the trench size excavated up to the maximum size of trench allowable under these specifications. Only that special bedding for which there are stipulated costs, or for which special bid items are listed in the bid sheet will be measured for payment.

No allowance will be made for over-excavation except as directed by the Engineer, or for special bedding required in the contract work under other bid items.

7. Bore Casing. Will be measured on the basis of horizontal centerline distance and shall include all excavation, furnishing and placement of casing, furnishing and placement of all required back-packing and grouting around casing, backfilling within casing, pipe bracing, restoration of surfaces, and all labor and material for a finished job. Furnishing and installation of pipe within casing shall be included in pipeline measurement.
 8. Paving. Will be measured as a part of project causing removal and/or replacement of paving, except as otherwise specified on the Bidding Sheet.
- B. Payment. Payment for quantities for installation of pipeline and appurtenances on District-administered contracts will be paid for in the following manner. Quantities of items listed herein, measured as stated above and accepted, will be paid for at the unit bid prices as stated herein, which prices and payments shall constitute full compensation for furnishing all labor, equipment and tools necessary to complete the described work in place. No additional compensation will be paid above the unit bid prices for changes in quantities.

1. Pipelines. Quantities of pipelines will be paid for at the respective unit bid prices per horizontal linear foot for the kinds and sizes of pipe stated in the bidding sheet. Work includes all earthwork, installation and testing of pipe, specials, fittings, welding, anchors, removal and restoration of pavement, curbs, gutters and sidewalks, and clean-up. Payment for pipe in place shall be further broken down based upon the Contractor's submittal under Section F-10 of the General Conditions, as concurred by the Engineer, but not to exceed in the ordinary project the following percentages of the linear foot price stated on the Bidding Sheet:

Trench excavation	10%
Pipe laid in place and shaded.....	65%
Trench Backfilled and the Backfill Compacted.....	20%
Testing and Clean-up, Exclusive of Pavement Replacement	5%

2. Fittings and Specials. Payments for quantities of fittings and specials shall be included in the payment for installation of pipelines. Work includes installation of bends, tees, crosses, joint restrainers, couplings, saddles, outlets, tapers, butt straps and all necessary cuts and welding and all earthwork, and no additional compensation will be made therefore.
3. Valves. Quantities of gate valves or butterfly valves will be paid for at the respective unit bid prices for the size of valves stated in the bidding sheet. Work includes installation of valves, valve risers and caps, saddles, flanges, gaskets, bolts, and all earthwork.
4. Air Valves. Quantities of air valve assemblies will be paid for at the respective unit bid prices for the size of air valves stated in the bidding sheet. Work includes installation of tap-to-main, valves, service stops, elbows, bends, valve boxes, and all piping.
5. Fire Hydrants. Quantities of fire hydrant assemblies will be paid for at the respective unit bid prices for the sizes of fire hydrants stated in the bidding sheet. Work includes installation of tap-to-main, valves, valve risers and caps, saddles, bends, flanges, gaskets, bolts, hydrants, and all piping.
6. Blow-offs. Quantities of blow-off assemblies will be paid for at the respective unit bid prices for the sizes of blow-offs stated in the bidding sheet. Work includes installation of tap-to-main, valves, valve risers and caps, fittings, earthwork and miscellaneous materials.

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7. Special Bedding. Quantities of special bedding measured as stated above and accepted, will be paid for at the stipulated cost price, or the respective unit bid price for the quantities as stated in the bidding sheet, which price shall constitute full compensation for all labor, materials, and equipment necessary to complete the work in place, including the special bedding material.
8. Bore Casing. Payment for bore casing in place measured as stated above shall be made as specified on the bidding sheet.
9. Paving. Payment for quantities of paving measured as stated above and accepted shall be included in the unit bid for pipeline. Work includes removal and/or restoration of paving and all earthwork, and no additional compensation will be made therefore, except as otherwise provided on the bidding sheet.

1.07 GUARANTEE

All work, materials, and equipment shall be guaranteed for the periods of time set forth elsewhere in the contract documents for General Guaranty or Warranty.

PART 2 - PRODUCTS & MATERIALS

2.01 SERVICE CONNECTIONS

Service connections to asbestos-cement pipe main shall be by prefabricated heavy tapped couplings for 3/4", 1" & 1/2" Meter Service Connections. Service connections to ductile iron pipe and PVC pipe shall be made using service saddles.

2.02 FLANGE X HUB-END VALVES

Where valves do not connect to fittings, the fitting may be hub-end, or flange x hub-end. However, where valves connect to cast iron or welded steel fittings, fittings shall be flanged. Where flange x hub-end valves are not available for use with asbestos-cement pipe, flanged valves shall be used with flange x hub-end adaptors. All fittings and valves for ductile iron pipe and PVC pipe shall be bolted mechanical joint type.

All valves shall be hung plumb, with the stems vertical.

2.03 PORTLAND CEMENT CONCRETE

Cast-in-place structures of plain and reinforced concrete shall conform to the requirements of Chapter 26 of the Uniform Building Code and ACI 318, unless otherwise approved by the Engineer.

Classes of concrete used in the construction of cast-in-place structures shall be proportioned as specified in Section 03300 of the District standard specifications.

2.04 CEMENT MORTAR PIPE JOINTS

Mortared joints shall meet the following requirements:

A. Joint Mortar

1. Composition of mortar for caulking, buttering, or coating of joints shall be composed of cement, sand and water, well mixed and of such consistency as to produce a dense, homogeneous mortar that will adhere firmly to the pipe surface. Sufficient hand plastering of the joint prior to placing of the mortar is to be encouraged, to enhance the bond between the pipe and mortar.
 - a) Cement shall be Type V Portland Cement (sulfate resistant)
 - b) Water for mixing mortar shall be clean and free from mud, oil, organic material, or other deleterious substances.
 - c) Aggregate sand shall be silica sand passing at No. 16 mesh screen; or "plaster" sand at least 80% passing a No. 16 mesh screen; or other well graded inert, granular material produced from hard rock, with strong, durable, uncoated grains, upon prior approval of the District.
2. Proportions of cement and sand in joint mortar shall be one part of Portland cement to one and one-half parts of sand by volume. The exact proportion shall be determined by the characteristics of the sand used, and approved by the Engineer.
3. Water content shall be kept to the minimum allowing workability, as approved by the District, recognizing that better flow characteristics are required for placement in diapers around the pipe than for placement by caulking or buttering.
4. Mixing of the mortar should be long enough (approximately 3 minutes in paddle-type mixers, or 1 minute in turbine mixers) to obtain maximum plasticity. The mortar shall be used before initial set; therefore, only enough mortar shall be mixed at a time for immediate use even to the extent of discarding mortar already mixed in the event of delay in the pipelaying operation.

B. Diapers shall be impervious if available.

1. Width of diapers, where used, shall be sufficient to allow cupping of the diaper for increased thickness of the joint mortar. Recommended minimum diaper widths:

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20" dia. pipe and larger:.....	12"
12" - 18" dia. pipe:	10"
10" dia. pipe and smaller:	9"

2. Mortar placement shall be from one side of the diaper, to allow the mortar to flow around the bottom and up the opposite side of the pipe, to preclude the possibility of any voids inside the diaper.

C. Curing operations shall begin immediately after completion of joint mortaring.

1. Immediate backfill should follow the completion of the joint mortaring operation where possible. Care must be taken to immediately wet down and consolidate the backfill, to avoid draining the moisture from the mortar through porous diapers into dry backfill soil, or disturbing the mortar set by subsequent compaction of the backfill.
2. Completed-joint mortar to be exposed to the sunlight where backfill will not take place until after the mortar has hardened must be kept continually moist during the curing period to prevent cracking of the curing mortar.

2.05 LOCATOR WIRE

Locator wire shall be installed over all waterlines, reclaimed waterlines and forcemains whether or not telemetry wire is buried with pipe. Locator wire per Standard Drawing B-656 shall be 14-1 solid insulated copper wire (UF), in a continuous strand, placed on top of pipe and secured with tape. Locator wire shall be brought to the surface at the edge of the right of way at 660 feet maximum on centers in Brooks No. 1-SP, or equal, valve boxes.

The valve boxes shall be placed within two feet of fire hydrants when fire hydrants are available at 660' or less on center. Where no fire hydrants are available, EMWD marker posts shall be installed within two feet of the valve boxes.

For subdivision construction, instead of the marker post, mark the face of the curb in front of the box with the letters "LW". Loop 2 feet of wire in valve box. Provide the inspector survey stations at each valve box for as-built drawings.

After all trench backfill operations are complete, the District shall pay for and conduct the locatibility test to confirm that the wire is continuous. The Contractor shall be responsible for all costs to confirm, locate and repair any breaks in the location wire identified in the locatibility test. In addition, the Contractor shall reimburse the District for all costs to retest repaired sections of the wire. The Contractor is advised to use care in the installation and backfilling operations to prevent damage to the wire.

2.06 TELEMETRY CABLE

On District-administered contracts, the District will supply the telemetry cable for installation in accordance with these specifications and contract drawings. The telemetry cable will be delivered to the Contractor at the District's warehouse. Prior to acceptance and delivery of the cable, a continuity test will be performed by District personnel or the Contractor's representative. Certification of the test results will be acknowledged by the Contractor or his representative in writing. The Contractor will be responsible for the safe handling, installation and retesting for total continuity of the cable installation prior to acceptance by the District.

2.07 POLYETHYLENE ENCASEMENT

All underground installed valves, ductile iron pipe and fittings shall be polyethylene encased at the time of installation. Polyethylene encasement and installation shall be in accordance with ANSI/AWWA C105/A21.5.

2.08 JOINT BONDS

All metallic pipes shall be electrically continuous except at insulating flanges. All joints that are not welded shall have bonds to ensure continuity.

Cathodic test stations and/or Insulated Test Connection 4-wire test stations shall be installed at every half mile or less except where otherwise indicated on the plans.

2.09 DROPS AND SIPHONS

All waterline drops and siphons larger than 12" shall be CML&C. A soil corrosivity report with recommendations shall be prepared by a corrosion engineer and submitted to the District for approval prior to construction.

PART 3 - EXECUTION

3.01 GENERAL

It shall be the responsibility of the Contractor, prior to start of construction, to meet with the Engineer:

- A. For approval of schedule of construction for work and completion of pipelines or sections thereof.
- B. To submit the required forms listed in the General Conditions.
- C. To coordinate delivery of District-furnished materials.
 1. Determine location and placing of the pipe to be unloaded and direction of placing bells;
 2. Determine the quantity of pipe to be placed in a particular location;
 3. Coordinate delivery of pipe and other materials to meet his construction schedule.

- D. To furnish such additional information as may be required from time to time as construction progresses, regarding the progress of the procurement and delivery of the required equipment and materials, and/or the scheduling of the work.

Any subsequent shuttling of pipe, turning of bells, etc., will be at the Contractor's expense and no additional compensation will be allowed above the unit bid price, unless authorized by the Engineer in writing. All quantities shown on the Bidding Sheet and the contract drawings indicate the estimated quantities of materials for the completed pipelines in place.

3.02 BEDDING PIPE

- A. General. Each section of pipe shall be lowered into the trench in a manner that will prevent injury to the pipe, coating, or joints and shall be carefully bedded to provide continuous bearing and prevent uneven settlement. The inside of the pipe shall be clean and free from foreign material of any kind before being installed.
- B. Steel Pipe. For bedding steel pipe without encasement, the trench bottom shall be given a final trim such that each pipe section first laid will be continuously in contact with the ground along the bottom as shown on the drawings, provided that in the event ground is encountered which, due to its instability or other properties, but through no fault of the Contractor, cannot be trimmed in the prescribed manner or made to retain the specified shape, a 2-inch bedding or other suitable modification of the method of bedding the pipe will be ordered by the Engineer. Bellholes will be provided to prevent bridging the pipe supported at the bells.

Wherever, due to over-excavation or inaccurate trimming by carelessness in the operation of the Contractor's equipment or by his workmen, the shaping is inadequate to afford uniform support for the normal bedding of the pipe, the Contractor at his own expense, shall refill with sand, consolidate, and then reshape the trench bottom to the required section.

Pipe zone bedding shall be completed in accordance with the requirements of the District standards and/or the manufacturer's trench section bid submittal.

- C. Asbestos-Cement Pipe. Asbestos-cement pipe without encasement shall be installed in accordance with AWWA Spec. C603, shall be bedded in accordance with Section 3.2 of that specification for pipe laid on earth mounds, and in accordance with the standard drawings.
- D. Ductile Iron Pipe. Ductile iron pipe without encasement shall be installed in accordance with AWWA Spec. C600.

- E. PVC Pipe. PVC pipe without encasement shall be installed in accordance with ASTM D-2774-82.

For PVC pipe and ductile iron pipe with mechanical joints, the gasket shall be placed in the groove of the bell. Lubricate the spigot lead of the pipe, keeping it clean and free of dirt or sand and then insert the spigot end into the bell and force into position per manufacturer's recommendation.

- F. Tolerance. The pipe shall be accurately laid to alignment and grade shown on the drawings or established by the Engineer. Where grade stakes are provided with which to establish the proper pipeline grade, pipe shall be laid to grade within a tolerance of 0.1', or 0.2' cumulative deviation from elevations set by adjacent grade stakes. As ordered by the Engineer, the allowed tolerance may be greater than herein indicated for lines on steep grades, or less than herein indicated for the larger lines or lines on flat grades, where necessary to avoid air pockets.

3.03 RUBBER GASKET PIPE JOINTS

After the subgrade has been prepared as specified, the rubber gasket shall be placed in the groove on the spigot ring, and the spigot end of the pipe then entered into the bell of the adjoining pipe and forced into position. Care shall be taken to avoid twisting or cutting the gasket when jointing the pipe. The inside surface of the bell shall be lubricated with a compound of Sherwin-Williams Fluxsoap or approved equal which will facilitate the telescoping of the joint.

- A. Lining. For steel pipe smaller than 21 inches, buttering of joints with cement mortar and drawing sewer ball or an approved swab or squeegee through the pipe may be substituted in place of caulking and troweling. Water shall not be turned into the pipe until the inside joints have been properly cured.
- B. Coating. In the case of wrapped steel pipe, the outside joints shall be completely primed with Primer 1170 and wrapped with Protecto-Wrap.

In case of cement mortar coated steel pipe, the outside joints shall be completely coated with cement mortar using diapers as set forth in Article 2.04, Cement Mortar Pipe Joints.

All field coatings other than joint mortar shall be shaded with pipe zone backfill after their initial set, but prior to four (4) hours following installation, and properly protected during the shading operation. Joint mortar shall be cured as set forth in Article 2.04, Cement Mortar Pipe Joints.

3.04 CURVES, ANGLES, CLOSURES AND SHORT SECTIONS

The laying of pipe on curved alignment by means of unsymmetrical closure of spigot into bell rings will be permitted. The amount of pull permitted from normal closure on one side of the joint will be up to 1/2" for 8" pipe or smaller, up to 3/4" for 10" through 21" pipe, and up to 1" for pipe 24" and larger; provided that the maximum deflection shall not exceed the manufacturer's recommendation. Where smaller radius of curvature is required, sections of pipe with beveled ends may be fabricated for the purpose and laid on curved alignment, unless fabricated bends are shown on the drawings or ordered by the Engineer. Beveled pipe may have a maximum bevel of five degrees measured from a plane perpendicular to the pipe's axis. The center of the short side of the bevel shall be marked on the joint bands. For the purpose of reducing the angular deflections at pipe joints and for closure sections, the Contractor shall be permitted to install pipe sections of less than standard length. Where such installations are allowed, Contractor shall be responsible for anchorage of the necessary joints, as directed by the Engineer. Curved Sections of PVC pipe shall be in accordance with AWWA C-900 and manufacturer's recommendations.

Closing courses and short sections of straight pipe shall be fabricated and installed by the Contractor as found necessary in the field and approved. Where closing pieces are required, the Contractor shall make all necessary measurements and shall be responsible for the correctness. Other than closing courses and short sections approved by the Engineer for field fabrication, all pipe and special fittings shall be fabricated in a shop approved by the Engineer for that purpose.

Asbestos-cement pipe cutting or beveling operations shall utilize tools that do not produce concentrations of airborne asbestos dust exceeding levels permitted by regulatory agencies.

PVC pipe shall be cut square, deburred and beveled in accordance with pipe manufacturer's recommendations. The pipe shall be cut in a neat and workmanlike manner without damage to the pipe.

3.05 WELDING

The Contractor shall be responsible for the quality of work performed by his welding organization. All welding operators shall be qualified under the Standard Qualification procedure of the American Welding Society. All welds shall be made by an electric shielded arc method of welding. When continuous welded pipe is specified, the Contractor shall use filler rods made of the same material as the cans, per the manufacturer's recommendations. No bending of the pipe shall be allowed.

All pipe welds at joints and fittings shall be double pass full welds. Welding shall be performed only after any mortar within two (2) feet has a 24-hour set.

The Engineer shall have the right at any time to call for and witness the making of test specimens by any welder in accordance with these specifications, and the expense of such tests shall be borne by the Contractor.

Welds considered by the Engineer to be deficient in quality, or made contrary to any mandatory provision of these specifications, shall be removed by chipping or melting, and shall be remade. The weld-metal shall be removed throughout its depth to expose clean base metal, but in case of a strictly local deficiency, the weld need not be removed throughout its entire length, provided that a sufficient amount shall be removed to insure that sound weld metal only remains. A cracked weld shall be removed throughout its length.

3.06 JOINT INSPECTION

For sizes smaller than 30 inch, Contractor must provide closed circuit television inspection (CCTV) as a post-construction method to determine if the pipeline has been installed as required and all joints have been properly finished. CCTV system shall have a rotating lens camera with articulating head. Each joint will be scanned 360 degrees. The television camera shall be specifically designed and constructed for water pipe inspection. The camera shall be operative in 100% humidity conditions. Lighting for the camera shall minimize relative glare. Lighting and camera quality shall be suitable to provide a clear, in focus picture of the entire periphery of the water pipe for all conditions encountered during the work. Focal distance shall be adjustable through a range from 6" to infinity. The remote reading footage counter shall be accurate to one percent (1%) over the length of the particular section being inspected. The camera, television monitor and other components of the color video system shall be capable of producing a minimum of 350 line resolution. Documentation consisting of a color video tape and a written report detailing the condition of the mainline and joints shall be submitted to EMWD for approval prior to pressure testing.

Any defects in the pipe lining or joints, shall be repaired and another video taken of the repaired section and submitted for approval by EMWD prior to pressure testing. **For domestic water systems, all video equipment must be certified for DOMESTIC WATER LINE INSPECTION ONLY, and NEVER to have been utilized in a non-potable system.**

3.07 FIRE HYDRANT RUNS

In asbestos-cement pipe, ductile iron pipe, and PVC pipe systems where thrust blocks are required, trenches shall be trimmed neat to avoid encroachment of the thrust block into the area of future utility trench assignment.

3.08 FLANGE, FITTING AND BOLT CORROSION PROTECTION

All corporation stops, valves and other appurtenances and fittings at the pipeline shall be primed, and wrapped with Protecto-Wrap No. 200 or 300 Coal Tar Resin tape. Bolts and nuts shall be protected using zinc caps anodes in accordance with section 15089.

Fittings and valves on pipeline shall be encased in alkalized sandslurry envelope between 12" and 18" thick. Composition 50 lb. hydrated lime per cubic yard of sand.

All bare iron and steel shall be field coated with one of the following as directed by the Engineer:

- A. Protecto-Wrap #1170 primer and #200 or #300 Coal Tar Resin tape; or

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- B. two coats of Koppers Supertank solution; or
- C. cement mortar meeting the requirements of Article 2.04.

3.09 VALVE CAP AND RISER INSTALLATION

In new subdivision developments, Contractor shall leave valve cans 3" minimum below rough-graded subgrade street surface, properly covered, and shall return after paving of the streets is completed by others, to raise the valve slip can and cap to grade. Contractor shall coordinate his work with that of the paving contractor to place the slip can during placement of the road sub-base, if desirable.

3.10 SERVICE CONNECTION METER BOX LOCATIONS AND METER INSTALLATION

Service connections shall be installed by the Contractor of the size and at the locations shown on the standard drawings, with meter boxes located as shown on the standard drawing for the proper size meter service connection. Where meter installation is indicated on the standard drawings, spacers as shown on the standard drawings shall be furnished and installed by the Contractor for later installation of meters to be furnished and installed by the District.

Except as specifically stated otherwise, or as coordinated by the Engineer upon mutual agreement during construction, meter boxes shall be set after curbs have been constructed in those areas involving curb construction in the street improvement, and after grading of the parkway or road shoulders. The Contractor shall maintain the meter boxes within County road improvements until those improvements are accepted by the County.

3.11 SERVICE CONNECTIONS

Service connections to asbestos-cement pipe shall utilize heavy tapped couplings where service connections are made or locations are known at the time of main installation. Service connections to ductile iron pipe and PVC pipe shall utilize service saddles. Water Service Compression Couplings where required or permitted, shall utilize a stainless steel insert in accordance with the drawings. The stainless insert specified shall be a full circle insert; split or collapsible inserts will not be accepted.

3.12 ELECTROLYSIS FACILITIES

Such as insulating flanges, test connection stations, and bonding of pipe joints shall be installed to eliminate conductivity of electrical current or to ensure such conductivity, whichever is appropriate. Inasmuch as the testing of these installations requires specialized equipment, any tests required by the Engineer will be performed by the District or its agent at District expense on District-administered contracts. The electrical potential and current necessary to successfully test the installation shall be determined by the District or its agent for each individual facility, dependent upon such factors as the pipe-to-soil potentials available.

3.13 TEMPORARY BUMPHEADS

The Contractor shall furnish and install complete, all the necessary temporary bumpheads or skillets and appurtenances thereto in the pipeline used for backfilling or testing purposes and shall remove such bumpheads upon completion of the line.

The Contractor shall furnish, at his own expense, any openings in the pipeline or bumphead and any valves or by-pass arrangements which are for his convenience in filling, testing and/or emptying the pipeline.

At all times when the work of installing pipe is not in progress, all openings into the pipe and the ends of the pipe in the trench shall be tightly closed to prevent entrance of animals and foreign materials.

The Contractor shall take all necessary precautions to prevent the pipe from floating due to water entering the trench from any source, shall assume full responsibility for any damage due to this cause and shall at his own expense restore and replace the pipe to its specified condition and grade if it is displaced due to floating.

If the Contractor, upon approval by the Engineer, elects to test a system utilizing valves and connecting pipe installed by the District, the District will assume responsibility for any leaks occurring in any pipeline or valve furnished and installed by the District. In the event Contractor is unable to satisfactorily test his system because of leaks in the District-installed system, Contractor shall install temporary bumpheads in his construction to perform tests, as determined necessary by the Engineer. Full compensation for furnishing all labor, tools, materials, and equipment (except water when provided by the District), and for doing all work involved in testing, and for repairing any leaks shall be included in the price paid for installation of the pipe, and no additional compensation by the District will be allowed therefore.

3.14 FIELD HYDROSTATIC TEST

Upon completion of the laying, jointing, backfilling, and proper curing of the joints, and compaction of backfill, the pipeline or portions thereof shall be hydrostatically tested.

For convenience of testing, the pipeline may be divided into sections and each section tested separately. Main line valves may be used in lieu of special bumpheads, or if valves are not conveniently located, temporary bumpheads shall be constructed. Bumpheads shall be constructed to safely withstand the hydraulic pressures imposed upon them. No payment will be made expressly for the work and materials required for the bumpheads and any compensation desired by the Contractor for this work shall be included in the price quoted for the installation of pipe. The Contractor shall have no claim against the District by reason of required construction of bumpheads due to the omission of the installation of any or all main line valves.

After the section of pipeline has been bumpheaded and completely filled with water, it shall be allowed to stand under pressure a sufficient time to allow the pipe to obtain a maximum absorption of water and to allow the escape of air from any air pockets. The pressure shall then be increased to the specified test pressure as hereinafter described, and shall be maintained at this pressure for not less than four (4) hours.

All pipes shall be tested under a pressure 1 1/2 times the pressure rating of the pipe, but not less than 150 pounds per square inch. Maximum test pressure shall not exceed 225 pounds per square inch unless otherwise specified by the Engineer.

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As a matter of information, valves specified elsewhere for installation shall meet the following conditions:

Gate Valves

AWWA C-500 requires:

12" & smaller: 200 psig rated working pressure

16" & larger: 150 psig rated working pressure

At these pressures, allowable hydrostatic leakage rate is
1 fl. oz./hour/inch of nominal valve size.

Butterfly Valves

AWWA C-504 requires:

3" - 72": 150 psi working pressure

Allowable leakage:

Drip-tight at 150 psi hydrostatic pressure differential

Dresser 450 [AWWA Class 150-B (150 psi)]

4" - 12": 200 psi rated working pressure

14" & larger: 150 psi rated working pressure

Allowable leakage:

Bottle tight at rated working pressure differential

If testing is against gate valves and leakage is detected through the valve, additional leakage over and above the allowable leakage for the pipeline may be allowed at the rate of 1 fl. oz./hour/inch of valve diameter. There will be no allowance for leakage through butterfly valve.

If any leakage is evidenced in the testing of the pipeline, the various sections of the pipeline shall be isolated for testing between available valves, or between bumpheads located as directed by the Engineer. The maximum allowable leakage for asbestos-cement pipe shall be ten (10) gallons per day per mile of pipe per inch of pipe inside diameter. The maximum allowable leakage for steel pipe shall be two (2) gallons per day per mile of pipe per inch of pipe inside diameter. The maximum allowable leakage for ductile iron pipe shall be seven (7) gallons per day per mile of pipe per inch of pipe inside diameter. The maximum allowable for PVC pipe shall be six (6) gallons per day per mile of pipe per inch of pipe inside diameter. If the leakage exceeds this amount, the section being tested will be considered defective. The Contractor shall determine the points of leakage, make the necessary repairs and perform another test. This procedure shall be continued until the leakage in each section falls below the allowable maximum for that section of pipeline.

Leakage shall be determined by metering the water injected into the pipeline while under the required pressure. The Contractor shall submit to the District before and after the test the gage and meter used so that these devices may be tested by this District.

The Contractor shall provide all calibrated meters for measurement of leakage, all bumpheads or skillets, piping, calibrated gages, pumps and other equipment, all water not furnished by the District, and all power and labor necessary for the performance of pressure tests satisfactory to the Engineer. The Contractor shall furnish all necessary equipment and labor to fill each section of pipeline tested and for pumping the water from one test section to another as may be necessary for obtaining and maintaining the required water pressure and for filling the entire pipeline with water after the conclusion of the testing, as hereinafter provided.

The Contractor, at his own expense, shall do any excavation necessary to locate and repair leaks or other defects which may develop under test, including removal of backfill already placed, shall replace such excavated material, and shall make all repairs necessary to meet the required water tightness after which the test shall be repeated until the pipe meets the test requirements. All tests shall be made in the presence of the Engineer. After the pipe has met successfully all test requirements specified herein, the entire pipeline shall be filled with water and so maintained until the completion of the contract unless otherwise ordered by the Engineer.

3.15 CHLORINATION

- A. Flushing. Sections of pipe to be disinfected shall first be flushed to remove any solids or contaminated material that may have become lodged in the pipe. If no hydrant is installed at the end of the main, then a tap should be provided large enough to develop a velocity of at least two and five-tenths (2.5) feet per second in the main. A two and one-half (2½) inch hydrant opening will, under normal pressures, provide this velocity in pipe sizes up to and including twelve (12) inch.

All taps required for chlorination, flushing purposes, or for temporary or permanent release of air shall be provided for by the CONTRACTOR as a part of the construction of water mains.

- B. Requirement of Chlorine. Before being placed into service, all new mains and repaired portions of, or extension to existing mains shall be chlorinated so that the initial chlorine residual is not less than 50 mg/l and that a chlorine residual of not less than twenty-five (25 mg/l) remains in the water after standing twenty-four (24) hours in the pipe.
- C. Form of Applied Chlorine. Chlorine shall be applied by one of the methods which follow subject to approval by the ENGINEER.
1. Liquid Chlorine. A Chlorine gas-water mixture shall be applied by means of a solution-feed chlorinating device, or the dry gas may be fed directly through proper devices for regulating the rate of flow and providing effective diffusion of the gas into the water within the pipe being treated. Chlorinating devices for feeding solutions of the chlorine gas, or the gas itself, must provide means for preventing the backflow of water into the chlorine.

- Chlorine-Bearing Compounds in Water. A mixture of water and high-test calcium hypochlorite (65-70% Chlorine) may be substituted for the chlorine gas water mixture. The dry powder shall first be mixed as a paste and then thinned to a one (1) percent chlorine solution by adding water to give a total quantity of seven and five-tenths (7.5) gallons of water per pound of dry powder. This solution shall be injected in one end of the section of main to be disinfected while filling the main with water in the amounts as shown in the table which follows:

Chlorine Requirements to Produce 50 mg/l
Concentration in 100 Foot of Pipe - By Diameter

<u>Pipe Size Inches</u>	<u>100% Chlorine Chlorine, LB.</u>	<u>1% Chlorine Solution, Gals.</u>
4	0.027	0.33
6	0.061	0.73
8	0.108	1.30
10	0.170	2.04
12	0.240	2.88

- Tablet Disinfection. Tablet disinfection is best suited to short extensions (up to 2500 ft.) and smaller diameter mains (up to 12 inch). Since preliminary flushing must be eliminated in using this method, it should be utilized only when scrupulous cleanliness has been used in construction. It should not be used if trench water or foreign material has entered the main or if the water is below 41 F.

Tablets should be placed in each section of pipe, hydrants, hydrant branches, and other appurtenances. Tablets must be at the top of the main and shall be attached by an adhesive, such as Permatex No. 1 or any alternative approved by the ENGINEER. Tablets in joints between pipe sections, hydrants, hydrant branches, or appurtenances are to be crushed and placed inside the annular space, rubbed like chalk in butt ends of sections to coat them if the type of assembly does not permit crushing.

In filling a section of piping with water when using the tablet method, water velocity shall be less than one (1) foot per second.

Number of 5-Grain Hypochlorite Tablets Required
for a Dosage of 50 MG/L per Length of Pipe Section

<u>Pipe Size</u> <u>Inches</u>	<u>Length of Pipe Section</u> -----Foot----->				
	<u>Up to 13</u>	<u>18</u>	<u>20</u>	<u>30</u>	<u>40</u>
2	1	1	1	1	1
4	1	1	2	2	2
6	2	2	3	3	4
10	3	5	7	7	9
12	5	6	10	10	14

- D. Point of Application. The preferred point of application of the chlorinating agent is at the beginning of the pipe line extension or any valved section of it, and through a corporation stop inserted in the pipe. The water injector for delivering the chlorine-bearing water into the pipe should be supplied from a tap made on the pressure side of the gate valve controlling the flow into the pipe line extension. Alternate points of application may be used when approved or directed by the ENGINEER.
- E. Preventing Reverse Flow. Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water. Check valves may be used if desired.
- F. Retention Period. Treated water shall be retained in the pipe at least twenty-four (24) hours. After this period, the chlorine residual at pipe extremities and at other representative points shall be at least twenty-five (25) mg/l.
- G. Chlorinating Valves and Hydrants. In the process of chlorinating newly laid pipe, all valves or other appurtenances shall be operated while the pipe line is filled with the chlorinating agent and under normal operating pressure.
- H. Final Flushing and Testing. Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipe at its extremity until the replacement water throughout its lengths shows upon test, a chlorine residual of less than one (1) mg/l. In the event chlorine is normally used in the source of supply, then the tests shall flow a residual of not in excess of that carried in the system.

After flushing, water samples collected on two (2) successive days from the treated piping system, as directed by the ENGINEER, shall show satisfactory bacteriological results.

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A minimum of one sample shall be taken from the end of the new main and one from each branch of the new main. If the new main is extremely long, then samples shall be collected along the length of the line as well as at its end. If trench water has entered the main during construction, or if excessive quantities of dirt or debris have entered the main, then bacteriological samples shall be taken every 200 feet at 24 hours after the final flush.

Each sample will be subjected to the MMO-MUG or approved method and Heterotrophic Plate Count.

If total and/or fecal coliform bacteria are present, then the sample fails and corrective action shall be performed, and a re-sample submitted.

If an HPC of greater than 500 colony forming units is found, then the sample fails State and Federal regulations.

For both the re-sample, and the replacement sample, it may be recommended that upstream and downstream samples are taken to eliminate the possibility of a poor sampling site. (Another way to eliminate a poor sampling site is to request that the contractor install a sampling station or a sampling spigot.) It may also be recommended that a source sample is obtained. This sample will be taken outside the influence of the main being tested, and labeled "source".

Bacteriological analysis must be performed by a laboratory certified by the California Department of Public Health.

- I. Repetition of Flushing and Testing. Should the initial treatment result in an unsatisfactory bacterial test, the original chlorination procedure shall be repeated by the CONTRACTOR until satisfactory results are obtained.

3.16 PIPE ENTRY RESTRICTIONS

No person shall enter a pipe that has not been checked for hazardous gases and oxygen concentration. Incapacitated persons in the pipe shall be practically accessible for rescue within five minutes.

The Contractor shall adhere to all the installation recommendations of the pipe manufacturer including any requirements for bedding and backfill before stull removal and joint mortar. The recommendations of the manufacturer shall be included in the prices bid for installation.

END OF SECTION 02718