

El Dorado Irrigation District

Technical Specifications



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33 01 30.13 SEWER SYSTEM TESTING	8/28/2017
31 23 33 TRENCH EXCAVATION, BACKFILL AND COMPACTION	8/28/2017

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GENERAL CONSTRUCTION REQUIREMENTS
(Developer Projects)

1.0 GENERAL

1.1 Scope - This section describes general conditions and requirements for construction of the water and sewer systems. The developer/engineer shall prepare such general and special supplemental conditions as are necessary to define the project specifics, nature and location of the work, contractual arrangements, payment for work and any other matters concerning the owner and his contractor. The District's Technical Specifications shall also be incorporated into and made a part of the contract for the construction of all projects.

2.0 PRECONSTRUCTION

2.1 Preconstruction Meeting - Following final approval of plans, signed agreements, payment of fees, and issuance of all permits, a preconstruction meeting shall be scheduled by the developer/engineer. No construction shall begin until a preconstruction meeting has been held with the District's Inspection Division. Five business days notice shall be given to schedule a preconstruction meeting.

2.2 A minimum of four copies of shop drawings and/or descriptive literature for materials proposed for use but not included in the District's "Manufacturer's List" shall be submitted to the District and receive favorable review prior to being used in the work. Prior to submittal to the District, each submittal shall be favorably reviewed by the contractor and engineer. To assure that each submittal has been first reviewed by the contractor and engineer, each submittal shall contain the date of review and the name of the reviewer for the contractor and engineer, along with a statement that the submittal has been reviewed and that it meets the specified requirements for the project. A stamp may be used for this purpose as long as the date and the signature are original for each submitted item. After review, two copies will be returned to the contractor.

Each submittal package shall include a Submittal Transmittal form containing the following information:

- A. Project Name and District Project Number.
- B. Contractor's name.
- C. The submittal item number, beginning with 001.
- D. Date of the submittal.

- E. The requested date of return of the submittal (not less than two weeks, and three weeks for electrical submittals).
- F. The specification section and paragraph number.
- G. Any deviation from project requirements or District standards.
- H. In the lower right hand corner, a 3" x 4" block shall be set aside for District use. This area shall remain free of text or drawing information. Each sheet of shop drawing or sketch submitted shall have the same size area and location dedicated for District use.

When the contractor elects to incorporate material included on the District's "Materials List" a complete product submittal will not be required, but the contractor shall submit a Certificate of Compliance from their supplier, certifying that the supplied item is on the District's Material List.

District review of any submittal shall not relieve the contractor of responsibility to comply with all requirements of the approved plans and District standards. District review shall be only for conformance with the design concept of the project and for compliance with the information given in the approved plans and shall not extend to means, methods, sequences, techniques or procedures of construction, safety precautions or programs incident thereto. The review of a component as such will not indicate acceptance of the assembly in which the item functions. The contractor will be responsible for coordination of assemblies consisting of separate components.

- 2.3 Substitutions - Articles or materials not specified by the District's Manufacturers List must be submitted to the District for consideration per Section 2.2.
- 2.4 Quality of Material - Materials and equipment to be incorporated into the project shall be new. In case a reference is not clear as to which of several available grades is desired, the highest quality material shall be used.
- 2.5 Permits - All permits shall be submitted to the District at the preconstruction meeting. The following shall be required of the contractor:
 - A. Encroachment - Where construction will encroach into the public right-of-way, the Contractor shall obtain all necessary encroachment permits from the County Department of Transportation and/or from Caltrans.
 - B. Explosives - Where the contractor anticipates the use of explosives in conjunction with construction, a blasting permit shall be first obtained from the appropriate agency, and all nearby property owners shall be notified (see Section 31 23 33).

3.0 CONSTRUCTION

3.1 Protection/Operation of Existing Facilities - A primary concern of the District, is the protection and operation of the District's facilities. No developer or contractor will be allowed to operate any existing valves or to cause a shutdown of any portion of the system without prior approval from the District's Operations and Maintenance (O&M) Department. Operation of valves during a shutdown will be done by O&M Department personnel. Any planned shutdown shall be discussed at the preconstruction meeting or at least three working days in advance of the work. Shutdowns will only be allowed if no other reasonable alternative exists, such as the use of a "hot-tap" connection. When shutdowns are required, the District will make an evaluation of whether the shutdown should be done during the day or during the night or on weekends. Contractor/developer economics will be weighed less heavily in the decision than in the interruption and inconvenience to existing customers. Any shutdown will require an approval of a notification plan for existing customers by the District.

3.2 Compaction Tests - The District will require certified compaction tests from the engineer/developer to confirm compliance with compaction specifications. Compaction shall be tested at locations selected by the Inspector.

The contractor shall make all necessary excavations for compaction tests as directed by the District.

3.3 Utilities and Existing Facilities - The contractor shall contact all owners of underground facilities known to be in the area of construction and request marking of these facilities through Underground Services Alert (USA). USA's phone number is (800) 642-2444.

The fact that any underground utility and/or facility is not shown on the plans shall not relieve the contractor's responsibility to comply with these standards. It shall be the contractor's responsibility to ascertain prior to commencing work, the existence of any underground utilities, which may be subject to damage by reason of his operations.

The District will locate its facilities upon satisfactory advanced notification.

3.4 Shipment and Delivery - All pipe shall be braced and studded to prevent damage during shipment. Any damaged pipe or fittings delivered and unloaded at trench side shall be removed by the contractor from the work site upon notification by the District Inspector.

Loading and unloading of pipe, as well as placement in the trench, shall be done with straps at each end. Chains, cables or other similar devices

that may damage the pipe, shall not be allowed to come into contact with the pipe.

- 3.5 Quality of Workmanship - All work shall be performed by persons experienced in the specific work, under competent supervision and in a manner satisfactory to the District.
- 3.6 Exposing Existing Facilities - When connections are to be made to any existing pipe or appurtenance where the actual size, elevation, or position of the facility is unknown, the contractor shall excavate and expose the existing facility prior to submitting the "Request for Tie-In" (Form E-9).
- 3.7 Connections to Existing Facilities - The contractor shall initiate a request for a connection to existing facilities on the form provided by the District. The contractor shall submit a form a minimum of three business days before the requested connection. Connections shall be scheduled only on Tuesdays through Thursdays. Connection requests that interrupt service to more than 10 customers shall be submitted not less than 5 business days before the connection date. Connections will not be approved for days before or after a holiday.

The operation of any existing District valve or other facility shall be by District personnel only.

The contractor shall be fully prepared to complete the connection in the time allotted and shall not stop work until the facilities are restored to service or until directed to do so by the District. All possible preparatory work shall be completed to the satisfaction of the District prior to a connection.

- 3.8 Hot Taps - The contractor shall notify the District Inspector of the scheduled time for all hot taps. Taps shall be made in accordance with the plans. All welds on steel mains shall be made by certified pipe welders.

The contractor shall initiate a request for a hot tap of existing facilities on the form provided by the District. The contractor shall submit the form a minimum of 3 business days before the requested hot tap. The contractor shall submit information on the tapping sleeve prior to submitting the request for a hot tap.

- 3.9 Abandonment - Abandonment of existing water lines, sewer lines, and/or structures shall be as shown on the plans. Pipelines cut shall be sealed with an appropriate plug.
- 3.10 Inspection Field Acceptance and Guarantee Period - The Engineering Department is responsible for inspection of all excavation and pipe laying

including appurtenant structures and trench backfill from trench foundation to subgrade. All such work shall be available for inspection at all times. Construction shall begin within five days after the preconstruction meeting. 48 hours notice shall be given prior to the start of any construction and 24 hours notice for specific inspection requests. Failure to provide proper notification may delay the starting date of inspection since the Engineering Department may not be able to inspect the work and cannot accept any work for which inspection has not been arranged. The primary responsibility for compliance with all District requirements and standards rests with the developer and/or contractor. Any acceptance of a portion of the work by a District Inspector does not relieve the developer/contractor of this basic responsibility.

Field acceptance is made by the District Inspector and will not coincide with the date of final acceptance of the work. The one-year warranty period for all work shall begin on the date of field acceptance. Any defective work discovered during this period shall be repaired or replaced and a new one-year period shall begin for that corrected work.

All overtime, holiday or weekend inspection will be subject to District approval.

Field acceptance will be withheld until work not accepted by the District is reconstructed and complies with District Standards.

- 3.11 Public Relations - The contractor shall conduct its affairs in a manner, which will minimize disturbance to residents in the vicinity of the work. The job site shall be maintained in a condition, which shall bring no discredit to the District or its personnel, and all affected improvements shall be restored to at least their original condition.
- 3.12 Defective Work - Any defective materials or workmanship, which shall become evident within one year after field acceptance; shall be replaced or repaired without cost to the District. Refusal of the contractor to correct defective work which is clearly his responsibility may be just cause to bring legal action to correct the deficiencies as well as to withhold exoneration of performance and payment bonds.
- 3.13 High Water Table - Where the water table is, or anticipated to be, within the trench excavation, pipe zone material shall be reviewed and have prior approval from the District. The District may require a sand/cement slurry or a fabric envelope of crushed rock.
- 3.14 Protection of Existing Utilities - The contractor shall be responsible for the care and protection of all existing sewer pipe, water pipe, gas mains,

culverts, or other facilities and structures that may be encountered in or near the area of the work.

In the event of damage to any existing facilities during the progress of the work and of the failure of the contractor to exercise the proper precautions, the contractor will pay for the cost of all repairs and protection to said facilities. The contractor's work may be stopped until repair operations are complete.

3.15 Recycled Water for Construction grading etc.

The following are the procedures and guidelines for the use of recycled water for construction grading, dust control, compaction and temporary reservoirs.

- A. All construction connections shall be tagged with warning tags, as follows: Warning- Reclaimed Water, Do Not Drink.

Use tags as manufactured by T. Christy Enterprises or approved equal. Tags shall be affixed to stationary tanks, water trucks, and all service points or any other inlet or outlet using recycled water.

- B. Water trucks, water tanks, or any other receptacle, including but not limited to pipe or hose used for storage or conveyance of recycled water must be approved through EID and the El Dorado County Department of Environmental Health.

- C. No fittings hose, or pipe, or any other appurtenance used for recycled water shall connect to a potable domestic water source.

- D. All PVC pipe extending from the point of connection to EID's system shall be marked: "Caution Recycled Water." The PVC piping shall conform to all material specifications as set forth by EID.

- E. Any water truck, water tank, or other storage receptacle to be converted from recycled water use to potable domestic water use shall be thoroughly cleaned and disinfected to the satisfaction of the El Dorado County Department of Environmental Health and EID.

Contact EID's Customer Services Department prior to connection to the District's system at (530) 622-4513, to arrange for inspection to ensure compliance with District Standards.

Failure to comply with any of the above requirements places the construction site in violation of District Rules and Regulations, and will result in termination of service until appropriate corrective steps have been taken.

END OF SECTION

CONCRETE AND REINFORCING STEEL

1.0 GENERAL

1.1 Scope - This specification includes concrete materials, mixing, placement, formwork, reinforcement and curing.

1.2 Submittals - Prior to placement, the following shall be submitted:

- A. Supplier's concrete mix data sheet showing contents and proportions of cement, aggregate, water, and any admixtures.
- B. Reinforcing steel schedule, if requested.

2.0 MATERIALS

2.1 Concrete - Portland cement concrete shall be composed of portland cement, fine aggregate, coarse aggregate, admixtures if used, and water, proportioned and mixed as specified in the Caltrans Standard Specifications Section 90, "Portland Cement Concrete".

Concrete for each portion of the work shall be of the class as shown below, for the type of work performed.

<u>Caltrans Class</u>	<u>Type of Work</u>	<u>Max. Slump (inches)</u>
A	All reinforced structures, manhole bases, piers, vaults	4
B	Anchors, thrust blocks, encasements, cradles, and miscellaneous unreinforced concrete	4
	Maximum water/cement ration to be 0.55	

Rapid setting concrete may be used. Accelerating admixtures may be added to the concrete mix as approved by the District.

2.2 Grout - Grout shall be composed of 1 part Type II Portland Cement to 1 ½ parts sand. The sand shall be washed, well-graded sand such that all will pass a No. 8 sieve. Water shall be clean potable water. The quantity of water to be used in the preparation of grout shall be the minimum required to produce a mixture sufficiently workable for the purpose intended. Grout shall attain a minimum compressive strength of 2,000 psi in 28 days.

Rapid setting, non-shrink, "5-minute" grout may be used or required in certain circumstances as approved by the District.

- 2.3 Reinforcing Steel - Reinforcing steel shall conform to ASTM A 615, Grade 60. Reinforcing steel shall be fabricated in accordance with the current edition of the Manual of Standard Practice, published by the Concrete Reinforcing Steel Institute. Reinforcing steel shall be delivered to the site bundled and tagged for identification.
- 2.4 Tie Wire - Tie wire shall be 16 gage minimum, black, soft annealed.
- 2.5 Bar Supports - Bar supports in beams and slabs exposed to view after form stripping shall be galvanized or plastic coated. Concrete supports shall be used for reinforcing concrete placed on grade.
- 2.6 Forms - Forms shall be accurately constructed of clean lumber and shall be braced to provide sufficient strength and rigidity to hold the concrete and to withstand the necessary pressure and consolidation without deflection from the prescribed lines.

The surface of forms against which concrete is placed shall be smooth and free from irregularities, dents, sags, or holes. The surface shall leave uniform form marks conforming to the general lines of the structure.

3.0 EXECUTION

- 3.1 Formwork - The contractor shall notify the District a minimum of one working day before his intended placement of concrete to enable the District to check the form lines, grades, and other required items before placement of concrete.

Unless otherwise indicated on the plans, all exposed sharp concrete edges shall be $\frac{3}{4}$ -inch chamfered.

Before placing concrete, the form surface shall be clean and coated with form oil of high penetrating qualities where applicable.

- 3.2 Reinforcement - Reinforcing steel shall be placed in accordance with the current edition of Recommended Practice for Placing Reinforcing Bars, published by the Concrete Reinforcing Steel Institute.

All reinforcing steel shall be of the required sizes and shapes and placed where shown on the drawings.

Reinforcing steel shall not be straightened or re-bent in a manner that will damage the material. The contractor shall not use bars with bends not

shown on the drawings. ALL STEEL SHALL BE COLD BENT - DO NOT USE HEAT.

All bars shall be free from rust, scale, oil, or any other coating which would reduce or destroy the bond between concrete and steel.

Reinforcement steel shall be positioned in accordance with the drawings and secured by using annealed wire ties or clips at intersections and supported by concrete or metal supports, spacers, or metal hangers. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage. Bars, additional to those shown on the drawings, which may be found necessary or desirable by the District for the purpose of securing reinforcement in position, shall be provided.

All reinforcing steel and wire mesh shall be completely encased in concrete. Reinforcement shall be placed a minimum of two-inches clear of any metal pipe or fittings. The reinforcement shall be so secured in position that it will not be displaced during the placement of concrete.

Reinforcing dowels shall be secured in place prior to placing concrete. The contractor shall not press dowels into the concrete after the concrete has been placed. The minimum lap for all reinforcement shall be 40 bar diameters. Additional reinforcement shall be placed around the pipe or openings as indicated in the drawings.

Wire mesh reinforcement is to be rolled flat before being placed in the form. The contractor shall support and tie wire mesh to prevent movement during concrete placement. Welded wire fabric shall be extended to within two inches of the edges of the slab. Splices shall be lapped at least 1 ½ courses of the fabric and a minimum of six inches. Laps and splices shall be securely tied at ends and at least every 24 inches with 16-gage black annealed steel wire. The contractor shall pull the fabric into position as the concrete is placed by means of hooks, and then work concrete under the steel to ensure that it is at the proper distance above the bottom of the slab.

- 3.3 Embedded Items - All embedded bolts, dowels, anchors and other embedded items shall be held correctly in place in the forms before concrete is placed.
- 3.4 Mixing and Placing Concrete - Concrete, either ready mix or batch mixed, shall be placed in the forms before taking its initial set. No concrete shall be placed in water except with approval of the District.

As the concrete is placed in the forms, or in excavations to be filled with concrete, it shall be thoroughly settled and compacted throughout the

entire layer by internal vibration and tamping bars. Concrete shall not be permitted to fall more than six feet and shall be deposited as nearly as practicable to its final position.

All concrete surfaces upon which or against which the concrete is to be placed, and to which new concrete is to adhere, shall be roughened, thoroughly cleaned, wet or sandblasted to bare aggregate as directed. An approved bonding agent shall be used before the concrete is deposited.

- 3.5 Concrete Finishing - Immediately upon the removal of forms, all voids shall be neatly filled with cement mortar.

The surfaces of concrete to be permanently exposed to view shall be smooth, free from projections, and thoroughly filled with mortar.

Exposed surfaces of concrete not finished against forms, such as horizontal or sloping surfaces, shall be screeded to a uniform surface and worked with suitable tools to a light broom finish.

- 3.6 Protection and Curing of Concrete - The contractor shall protect all concrete against damage. Exposed surfaces of new concrete shall be protected from the direct rays of the sun and from frost by being kept damp for at least two weeks after the concrete has been placed, or by using an approved curing process.

END OF SECTION

PRECAST CONCRETE VAULTS

1.0 GENERAL

- 1.1 Scope - The work covered by this section shall consist of furnishing all materials, accessories, equipment, tools, transportation, service, labor and performing all operations to furnish and install the precast concrete vaults in accordance with this section of the specifications and applicable drawings. Excavation and backfill to be in accordance with Section 31 23 16.

Precast concrete vaults and covers shall be manufactured in a plant especially designed for that purpose and shall conform to the shapes and dimensions indicated on the plans.

- 1.2 Submittals - Prior to installation the following is to be submitted:

A. Submit manufacturer's catalog data on precast items. Show dimensions of vault, thickness of walls, and top slab. Show reinforcing. Show materials of construction by ASTM reference and grade.

- 1.3 Design Loads - Design loads shall consist of dead load, live load, impact, and, in addition, loads due to water table and any other loads which may be imposed upon the structure. Live loads shall be for HS-20 per AASHTO standard specifications for highway bridges. Design wheel load shall be 16 kips. The live load shall be that which produces the maximum shears and bending moments in the structure. Minimum wall thickness shall be six inches.

2.0 MATERIALS

- 2.1 Concrete - Portland cement concrete shall conform to Class A as specified in the Caltrans Standard Specifications Section 90, "Portland Cement Concrete."

- 2.2 Reinforcement - Reinforcement shall be deformed reinforcement in accordance with ASTM A615 or ASTM A497 for welded deformed wire fabric.

- 2.3 Joint Sealing Compound - Joint sealing compound shall be impermeable to water; have high bonding strength to steel, concrete, etc., maintain permanent plasticity; resistant to applicable chemical exposure; and complies with the applicable Federal Specifications.

- 2.4 Access Door - Access doors shall be Type JD-AL as manufactured by the Bilco Company, New Haven, Conn., or equal.
- 2.5 Vents - Vents shall be constructed from 6-inch C-900 PVC pipe and fittings. Fittings shall be socket-welded type.

Each vault shall have two vents, one upper and one lower.

Install 304 stainless steel insect screen over vent openings above ground.

3.0 EXECUTION

- 3.1 Installation - Openings or "knockouts" in precast concrete vaults shall be located as shown on the drawings and shall be sized sufficiently to permit passage of the largest dimension of pipe and/or flange. Upon completion of installation, all voids or openings in the vault walls around pipes shall be filled with 3,000 psi non-shrink grout.

All joints between precast concrete vault sections shall be made watertight. The joint sealing compound shall be installed according to the manufacturer's recommendations to provide a watertight joint, which remains impermeable throughout the design life of the structure.

Access doors shall be built up so that the hatch is flush with the surrounding surface unless otherwise specified on the drawings or by the District. The contractor is responsible for placing the cover at the proper elevation where paving is to be installed and shall make all necessary adjustments so that the cover meets these requirements.

The vault floor shall contain an 18-inch diameter hole for installation of a gravity drain or sump. The vault floor shall be constructed so that there is a positive slope to the sump.

- 3.2 Exterior Coating - All exterior surfaces shall be coated with a minimum 30 mil (wft) of bitumastic 30 mil.

END OF SECTION

PAINTING AND COATING

1.0 GENERAL

1.1 Scope - This section governs materials and application of painting and coating for exposed pipe and appurtenances.

1.2 Submittals - Prior to application, the following shall be submitted:

A. Paint or coating manufacturer's product data sheet showing suitability of material for intended use including instruction on surface preparation and application.

1.3 Color Schedule - Above-ground or exposed facilities shall be color coded to differentiate from potable water, reclaimed water, and wastewater facilities as follows:

Potable Water: Medium Blue

Reclaimed Water: OSHA Safety Purple

Wastewater: OSHA Safety Green

2.0 MATERIALS

2.1 Alkyd Primer - All primer shall be lead free and rust-inhibitive synthetic-alkyd based. It shall be designed for use with an alkyd enamel finish coat.

2.2 Alkyd Enamel - Enamel shall be a high gloss industrial type, lead free, synthetic alkyd based, intended for use on exterior metal surfaces.

2.3 Bituminous Mastic - Bituminous mastic shall be coal-tar pitch based and shall have a minimum of 68% solids by volume.

2.4 Epoxy Paint - Epoxy shall be a colored polyamide cured epoxy with not less than 49% solids by volume.

All coatings and pigments to be used on potable water services shall have FDA approval for use with potable water.

3.0 EXECUTION

3.1 General - The requirements for painting and coating ferrous surfaces shall generally conform to the SSPC (Steel Structures Painting Council) and to

the manufacturer's recommendations. Application of the paint or coating system shall not be permitted if, in the opinion of the District, the equipment, climate, or safety conditions do not meet the above recommendations.

The contractor shall stir, strain, and keep coating materials at a uniform consistency during application. Each coating shall be applied evenly, free of brush marks, sags, runs and other evidence of poor workmanship. Finished surfaces shall be free from defects and blemishes.

The contractor shall not use thinners unless permitted by the District. If thinning is allowed, the maximum allowable amount of thinner per gallon of coating material as recommended by the manufacturer shall be used. Coating materials shall be stirred at all times when adding thinner and the coating material surface shall not be flooded with thinner prior to mixing. The contractor shall not reduce coating materials more than is absolutely necessary to obtain the proper application characteristics and to obtain the specified dry film thickness.

Deliver all paints to the job site in the original, unopened containers.

3.2 Surfaces not to be Coated - The following surfaces shall not be painted and shall be protected during the painting of adjacent areas:

- A. Mortar-coated pipe and fittings
- B. Concrete surfaces (i.e. vaults)
- C. Stainless steel
- D. Anodized aluminum
- E. Nameplates
- F. Manhole frames and covers
- G. Grease fittings
- H. Glass
- I. Brass, copper or bronze
- J. Platform gratings
- K. Buried pipe, unless specifically required in the piping specifications

3.3 Surface Preparation - The contractor shall not prepare more surface area than can be coated in one day. Pipe that has already been factory primed or painted shall not be sandblasted. All surfaces shall be prepared in accordance with the manufacturer's recommendations.

Wherever the words "solvent cleaning", "hand tool cleaning", "wire brushing", or "blast cleaning", or similar words are used in these specifications or in paint manufacturer's specifications, they shall be understood to refer to the applicable SSPC (Steel Structure Painting Council).

3.4 Shop Applied Primer - Surfaces that are shop primed shall receive a field touch up of primer to cover all scratches or abraded areas.

3.5 Alkyd Enamel - All above-ground or exposed piping, fire hydrants, and exposed metalwork shall be painted using an alkyd system.

A. Surface Preparation:

1. All rust, mill scale, or weld splatter shall be removed by sandblasting or power tool cleaning.
2. All unpainted surfaces shall be solvent cleaned.
3. All abraded or scratched enamel coatings shall be sanded smooth or receive power tool cleaning.
4. All failures in the existing coating shall be sandblasted.
5. All existing surfaces to be repainted shall be washed with TSP and stiff bristle brush.

B. Primer - All unpainted or damaged surfaces shall be coated with primer to a dry-film thickness or not less than 2 mils.

C. Finish Coat - The finish coats shall be two or more coats of alkyd enamel applied to a dry-film thickness of 3 mils, providing a total painted dry film thickness of not less than 5 mils.

3.6 Bituminous Mastic - Buried metal (flanges, non-stainless steel nuts and bolts, flexible couplings, exposed reinforcing steel, etc.) shall be coated with a minimum of 20 mils of bituminous mastic.

All surfaces coated with bituminous mastic shall be covered with 8 mil polyethylene wrap.

3.7 Epoxy Coating - Only those metal surfaces specifically called out, shall be epoxy coated and applied as follows:

A. Surfaces to be epoxy coated shall be sandblasted.

B. Sandblasted surfaces shall be coated with primer to a dry film thickness of 3 mils.

C. Two coats of epoxy paint shall be applied (4 mils each) to the primed surface. The manufacturer's recommended drying time between coats shall be followed.

D. The contractor shall prepare multiple-component coatings using all of the contents of the container for each component as packaged by the paint manufacturer. Partial batches and multiple component

coatings that have been mixed beyond their pot life shall not be used. Touch up paint shall be provided. The contractor shall mix only the components specified and furnished by the paint manufacturer. The contractor shall not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

3.8 Application Limitation - Paint or coating shall not be applied under the following conditions:

- A. When the surrounding air temperature or the temperature of the surface to be coated is below 40 degrees Fahrenheit or as recommended by the manufacturer of the specified coating system.
- B. When the temperature of the surface to be coated is more than 5 degrees Fahrenheit below the air temperature or when the surface temperature is over 120 degrees Fahrenheit .
- C. When the surface to be coated is wet, moist, or contaminated with any foreign matter.
- D. During rain, fog, or mist, or when the relative humidity exceeds 80%.
- E. When the temperature is less than 5 degrees Fahrenheit above the dewpoint.

If above conditions are prevalent, the application of coating shall be delayed or postponed until conditions are favorable. Dew or moisture condensation should be anticipated and if such conditions are prevalent, coating work shall be delayed until mid-morning to be certain that the surfaces are dry. The day's coating shall be completed in time to permit the film sufficient drying time prior to damage by climatic conditions.

If a change in climatic conditions damages a coating application, the contractor shall repair the damaged coating to its specified condition as directed by the District.

Paint shall be applied in such a manner as to assure an even, smooth, uniform adhering coat free from dirt, runs, brush marks and laps, and shall be applied as recommended by the manufacturer. Paint shall not be applied when freshly painted surfaces can become damaged by rain, fog, or condensation or when inclement weather can be anticipated. Fresh paint damaged by the elements shall be replaced by the contractor at his expense. Drop cloths shall be used to protect floors, equipment, piping and other exposed surfaces from spattering and spillage. Paint shall be

allowed to dry thoroughly between applications of successive coats. The manufacturer's recommended time between coats will be used as a guide by the District as to when the next coat of paint may be applied. The District must give approval before successive coats are applied.

The contractor shall notify the District after surface preparation and after the application of each coat of paint.

4.0 TESTING

- 4.1 General - The District will perform such tests as are required to ensure compliance with all phases of the work including surface preparation, abrasive blast cleaning, and the application of the coating systems.

If the item has an improper finish color or insufficient film thickness, the surface shall be cleaned and topcoated with the specified paint material to obtain the specified color and coverage. Visible areas of chipped, peeled, or abraded paint shall be hand or power-sanded, feathering the edges. The areas shall then be primed and finish coated in accordance with the specifications. Work shall be free of runs, bridges, shiners, laps, or other imperfections.

END OF SECTION

STRUCTURE EXCAVATION AND BACKFILL

1.0 GENERAL

- 1.1 Scope - This section shall govern the work for structure excavation and backfill. Structure excavation shall consist of the removal of material for the construction of foundations for vaults, manholes, or other structures, and other excavation designated on the Plans or in the Specifications as structure excavation. Trenching and backfill shall be in accordance with Section 31 23 33.

Structure excavation and structure backfill shall include the furnishing of all materials and equipment; the construction or installation of all facilities which may be necessary to perform the excavations and to place and compact the backfill; and the subsequent removal of such facilities, except where they are required or permitted by the Plans or Specifications to remain in place.

- 1.2 Submittals - Upon request, the following items shall be submitted and approved by the District.
- A. Test results showing gradation, durability and sand equivalent of import material.
 - B. Permit and notification form for excavations five feet or more in depth as required by Cal-OSHA, including any trench excavation or shoring plans.

2.0 MATERIALS

- 2.1 Excavation - Excavation is unclassified. The contractor shall complete all excavations regardless of the type of materials encountered. The contractor shall make his own estimate of the kind and extent of the various materials which will be encountered in the excavation.
- 2.2 Backfill - Native earth backfill and imported backfill material shall conform to the requirements of Section 31 23 33.

3.0 EXECUTION

- 3.1 Pavement - Bituminous or concrete pavements regardless of their thickness, and curbs and sidewalks shall be cut prior to excavation for the structure in accordance with the requirements of the encroachment permit or the District.

Pavement and concrete materials shall be removed from the site. These materials may be used as backfill if approved by the District.

- 3.2 Excavation - The sides of excavations for structures shall be sufficient to leave at least 1.5 feet clear as measured from the extreme outside of form work on the structure as the case may be. Where excavation is inadvertently carried below designated elevations, suitable provision shall be made at the expense of the contractor for adjustment of construction, as directed by the engineer to meet requirements incurred by the deeper excavation. No earth backfill will be permitted to correct overdepth excavation beneath structures, and overdepth excavation in such locations shall be rectified by backfilling with sand, graded gravel, or concrete as directed by the District.

- 3.3 Bracing - The contractor's design and installation of bracing and sheeting shall take the necessary precautions to be consistent with the rules, orders, and regulations of the State of California Construction Safety Orders.

Excavations shall be so braced, sheeted, and supported that they will be safe, such that the walls of the excavation will not slide or settle and all existing improvements of any kind, either on public or private property, will be fully protected from damage.

The sheeting, shoring, and bracing shall be arranged so as not to place any stress on portions of the completed work.

The contractor shall carefully remove sheeting, shoring, bracing, and timbering to prevent the caving or collapse of the excavation faces being supported.

- 3.4 Dewatering - The contractor shall provide and maintain means and devices to continuously remove and dispose of all water entering the excavation during construction of the structure and during backfill operations.

Water shall be disposed of in a manner that will prevent damage to adjacent property and pipe trenches.

The contractor shall not allow water to rise in the excavation until backfilling around and above the structure is completed.

- 3.5 Backfill - After structures and foundations are in place, backfill shall be placed to the original groundline or to the limits designated on the plans.

No material shall be deposited against cast-in-place concrete structures until the concrete has reached a compressive strength of at least 2,500 pounds per square inch.

Backfill material shall be placed in horizontal layers not exceeding 8 inches in depth.

3.6 Compaction - Compaction requirements shall be as follows:

Backfill within 5 feet of structure: 95% relative compaction.

Structural Backfill beyond 5 feet of structure: 90% relative compaction.

Gravel Base: 95% relative compaction.

Each layer of backfill material shall be moistened and thoroughly tamped, rolled, or otherwise compacted to the specified relative density.

Compaction equipment shall be carefully operated near structures to prevent their displacement or damage. Structural fill is to be placed and compacted in uniform layers around all sides of the structure.

3.7 Excess Excavated Material - The contractor shall make the necessary arrangements for, and shall remove and dispose of all excess excavated material.

All surplus material shall become the property of and be disposed of offsite by the contractor.

No excavated material shall be deposited on private property unless written permission from the owner thereof is secured by the contractor. Before the District will accept the work as being completed, the contractor shall file a written release signed by all property owners with whom he has entered into agreements for disposal of excess excavated material absolving the District from any liability connected therewith.

3.8 Restoration of Damaged Surfaces and Property - If any existing improvements, facilities, or vegetation not designated to be removed have been damaged, removed, or disturbed by the contractor, for whatever reason, such improvements, facilities and vegetation shall be replaced or repaired at the expense of the contractor.

3.9 Final Clean-up - After backfill has been completed, the right-of-way shall be dressed smooth and left in a neat and presentable condition to the satisfaction of the District.

END OF SECTION

TRENCH EXCAVATION, BACKFILL AND COMPACTION

1.0 GENERAL

- 1.1 Scope - This section governs the work for trench excavation, backfill and compaction for underground pipeline work.
- 1.2 Submittals - Upon request, the following items shall be submitted and approved by the District.
 - A. Test results showing gradation, durability and sand equivalent of pipe zone material. Additionally, for recycled aggregate base Tier 1 ESL results per the California Water Board regulations.
 - B. Permit and notification form for excavations five feet or more in depth as required by Cal-OSHA, including any trench excavation or shoring plans.
- 1.3 Testing - Testing frequency and location shall be approved by the District.

2.0 MATERIALS

- 2.1 Trench Excavation - Excavation is unclassified. The contractor shall complete all excavations regardless of the type of materials encountered. The contractor shall make his own estimate of the kind and extent of the various materials which will be encountered in the excavation.
- 2.2 Pipe Zone - Material for the pipe zone shall conform to one of the following:
 - A. Decomposed Granite - All decomposed granite shall be free of refuse, debris, miscellaneous or deleterious materials, vegetation, roots, and interspersed organic content. The sand equivalent shall not be less than 20 and a durability index of not less than 35.

<u>Sieve Size</u>	<u>Percent Passing</u>
3/8"	95-100
#4	75-100
#200	0-15

- B. Plug and Drain Material - When a plug and drain system has been approved by EID and the County DOT, pipe zone material shall be

Caltrans Standard permeable material designed for the specific condition.

2.3 Backfill – 12 inches above the top of the pipe to subgrade.

Backfill where in unpaved section shall be free from organic matter, debris, and rocks larger than 6 inches in diameter or length. The District shall be the sole judge of conformance of backfill material to this specification.

<u>Sieve Size</u>	<u>Percent Passing</u>
6"	100
3"	50
#4	35-100
#30	20-100

Backfill where in paved roadway section shall be ¾-inch and minus or ½-inch and minus aggregate base or approved alternative material with a sand equivalent of 30 minimum and a durability index of not less than 35. Recycled aggregate base must also meet the California Water Board's Environmental Screening Levels. All material shall generally conform to the following gradation:

<u>Sieve Size</u>	<u>Percent Passing</u>
¾"	90-100
#4	35-100
#30	20-100

2.4 Initial Material Testing – The District requires that all material shall be tested prior to use. After the material has been approved by the Engineer one truck load of material shall be delivered to the site. Under the direction of the Engineer the Contractor is required to have the onsite material tested and results provided to the District.

3.0 EXECUTION

3.1 Excavation - Excavation for pipelines, fittings, and appurtenances shall be open trench to the depth and in the direction necessary for the proper installation of the same as shown on the contract drawings or as otherwise approved by the Engineer. Excavation shall only proceed when the necessary materials have been delivered to the site.

The contractor shall bear all costs of disposing of roots and all other waste materials from the excavation. Material shall be disposed of in such a

manner as to meet all requirements of the state, county, and local regulations regarding health, safety, and public welfare. Non-flammable material and flammable material, when burning is not permitted, shall be disposed of off the construction site in an approved location at the contractor's expense.

The contractor shall remove obstructions within the trench area or adjacent thereto, such as abandoned concrete structures, logs, and debris of all types, without additional compensation. The Engineer may, if requested, make changes in the trench alignment to avoid major obstructions, if such alignment can be made without adversely affecting the intended function of the facility.

- A. Existing Pavement Removal - Pavement to be removed shall be removed and replaced in the manner prescribed by the agency issuing the encroachment permit.

Existing pavement, curbs, gutters, sidewalks and driveways to be removed in connection with construction shall be neatly saw cut prior to removal. Saw cuts shall have a minimum depth of one inch in concrete sidewalk. Concrete sidewalks or driveways shall be removed so that a minimum 30-inch square is replaced. If the saw cut in a sidewalk or driveway would fall within 30 inches of a construction joint, expansion joint, or edge, the concrete shall be removed and replaced to the joint or edge. If the saw cut would fall within 12 inches of a score mark, the concrete shall be removed and replaced to the score mark. Concrete shall be removed by jackhammer.

- B. Grading and Stockpiling - The contractor shall control grading in a manner to prevent water running into excavations. Obstructions of surface drainage shall be avoided and means shall be provided whereby storm and wastewater can be uninterrupted in existing gutters, other surface drains or temporary drains. Material for backfill or for protection of excavation in public roads from surface drainage shall be neatly placed and kept shaped so as to cause the least possible interference with public travel. Free access must be provided to all fire hydrants, water valves, meters and private drives.

- C. Line and Grade - The contractor shall excavate the trench to the lines and grades shown on the plans. Any deviations shall first be approved by the Engineer.

The trench shall be excavated to a minimum depth of 6 inches below the bottom of the pipe. The sides of the trench shall be excavated and maintained as nearly vertical as practical.

- D. Trench Support - The trench shall be adequately supported and the safety of workers provided for as required by the standard of the appropriate regulatory agency.

All shoring for open excavations shall conform to the State of California, Department of Industrial Relations and Division of Industrial Safety "Construction Safety Orders."

The contractor shall be responsible for adequately shored and braced excavations so that the earth will not slide, move or settle, and so that all existing improvements of any kind will be fully protected from damage.

No shoring once installed, shall be removed until the trench has been approved for backfill operations. Removal of shoring shall only be accomplished during backfill operations and in such a manner as to prevent any movement of the ground or damage to the pipe or other structures.

The contractor shall obtain all permits for any excavations over five feet in depth into which a person is required to descend or any excavation less than five feet in depth in soils where hazardous ground movement may be expected and into which a person is required to descend.

Excavated material shall not be placed closer than two feet from the top edge of the trench. Heavy equipment should not be used or placed near the sides of the trench unless the trench is adequately braced.

- E. Use of Explosives - Blasting for excavation will be permitted only after securing the approval of the Engineer and only when precautions are taken to eliminate danger to life or property. Explosives are to be stored in accordance with the provisions of DIVISION XI of the Health and Safety Code of the State of California. The contractor is responsible to secure any required permits for use and storage of explosives. The contractor shall notify the proper representatives of any public service corporation, or any individual at least 24 hours in advance of any blasting which may damage his or their property, along or adjacent to the construction zone.

Blasting mats shall be used at all times where flying rock might cause damage to any person, building, power line or other installation.

All traffic shall be stopped a safe distance from the blasting operation and all persons shall be removed from the area prior to blasting.

The contractor shall designate, in writing, a single responsible individual as Powder Foreman. Carelessness or incompetency by the powder foreman shall be grounds for immediate removal from said position or responsibility and the powder foreman shall not be permitted to handle or use explosives on the remainder of the project. Priming of all explosives shall be with electric detonators of sufficient size to ensure efficient and complete detonation of the explosive charge. All charges consisting of more than one hole shall be wired either as series or series-parallel. Straight parallel hookups will not be permitted.

The contractor is responsible to provide a power source adequate for detonation of the explosive charges consistent with the accepted standard practices involving electric detonation of explosives. Excessive blasting will not be permitted and any material outside the authorized cross section which may be loosened or shattered by blasting shall be removed.

The Engineer shall have authority to require the contractor to discontinue any method of blasting which leads to overshooting, is dangerous to the public, or is destructive to property or natural features. The contractor shall notify the District a minimum of two hours in advance of any blasting operations.

- F. Preservation of Trees - Excavation within the dripline of any tree shall conform to the following and to encroachment permits. Trees shall not be removed outside of fill or excavated areas, except as authorized by the District.

Tree roots larger than two inches in diameter shall not be cut and shall be kept moist during exposure. For damaged or severed root systems, trees shall be trimmed to compensate for the decreased root system. Trimming shall be done to the satisfaction of the inspector. All roots shall be neatly cut with saw or sharp cutter.

- G. Dewatering - The contractor shall provide and maintain, at all times during construction, ample means and devices with which to promptly remove and properly dispose of all water from any source

entering the excavations or other parts of the work. Dewatering shall be accomplished by methods which will ensure a dry excavation and preservation of the final lines and grades of the bottoms of excavations. Said methods may include well points, sump pumps, suitable rock or gravel placed below the required bedding for drainage and pumping purposes, temporary pipelines and other means, all subject to the approval of the Engineer.

Dewatering for the structures and pipelines shall commence when groundwater is first encountered and shall continue until the backfill at the pipe zone has been completed.

The contractor shall dispose of the water from the work in a suitable manner without damage to adjacent property. No water shall be drained into work built or under construction without prior consent of the Engineer. Water shall be disposed in such a manner as not to be a menace to public health.

The contractor shall be responsible to obtain all required Local and State Permits.

- H. Correction of Faulty Grades - Any over-excavation carried below the grade as specified or shown, shall be rectified by backfilling with approved decomposed granite and/or graded gravel, and shall be compacted to provide a firm and unyielding subgrade and/or foundation, as directed by the Engineer.
- I. Structure Protection - Temporary support, adequate protection and maintenance of all underground and surface structures, drains, sewers and other obstructions encountered in the progress of the work shall be furnished by the contractor at his expense and subject to the approval of the Engineer. Any structure that has been disturbed shall be restored upon completion of the work.
- J. Protection of Property and Surface Structures - Trees, shrubbery, fences, poles, and all other property and surface structures shall be protected unless their removal is shown on the drawings or authorized by the Engineer.
- K. Trench Width and Grade - The width of the trench within the pipe zone shall be such that the clear space between the barrel of the pipe and the trench wall shall not exceed the amount shown in the standard details. In general, the following shall be adhered to:

<u>Pipe Size</u>	<u>Total Trench Width</u>	
	<u>Minimum</u>	<u>Maximum</u>
6"	18"	24"
8"	20"	26"
12"	24"	30"
16"	40"	52"
20"	44"	56"
24"	48"	60"
30"	54"	66"
36"	60"	72"
42"	66"	78"
48"	72"	84"

Trench widths in excess of those specified must have prior written approval.

- L. Maximum Length of Open Trench - Unless otherwise specified or directed by the District, the maximum length of open trench shall be 500 feet, or the distance necessary to accommodate the amount of pipe installed in a single day, whichever is greater. The distance is the collective length of any location including open excavation, pipe laying, appurtenant construction and backfill which has not been temporarily resurfaced. Failure by the contractor to comply with the limitations specified herein may result in an order to halt progress of the work until compliance has been achieved. The contractor shall provide proper barricades for excavated areas.

3.2 Trench Foundation - The trench bottom shall be graded to provide a smooth, firm and stable foundation at every point throughout the length of the pipe. Should large gravel and cobbles be encountered at the trench bottom or pipe subgrade, they shall be removed from beneath the pipe and replaced with clean imported decomposed granite which shall be compacted to provide uniform support and a firm foundation.

- A. Foundations in Poor Soil - If excessively wet, soft, spongy, unstable or similarly unsuitable material is encountered at the surface upon which the bedding material is to be placed, the unsuitable material shall be removed to a depth as determined in the field by the Engineer. The contractor's attention is called to Section 3.1 G, regarding his responsibilities in maintaining adequate dewatering procedures to ensure that an otherwise stable foundation will not be rendered unfit due to accumulation of water.

3.3 Backfill and Compaction - Backfill shall be completed within the shortest possible time so that the construction area or street can be opened to

traffic. If for any reason construction of the pipeline or appurtenances thereto is delayed, the District may require that the trench be backfilled and such areas or streets opened to traffic.

- A. Pipe Zone-- After completion of the trench excavation and proper preparation of the foundation, six inches of bedding material shall be placed on the trench bottom for support under the pipe. Bell holes shall be dug to provide adequate clearance between the pipe bell and the bedding material. All pipe shall be installed in such a manner as to insure full support of the pipe barrel over its entire length. After the pipe is adjusted for line and grade and the joint is made, the remainder of the pipe bedding shall be placed to the limits as shown on the drawings. All bedding material shall be compacted 90% as measured by Test Method California 231, prior to placement of subsequent backfill.

When bedding material is selected, the pipe bedding backfill shall be brought to optimum moisture content and shall be placed by hand in layers not exceeding three inches in thickness to the centerline (springline) of the pipe and each layer shall be solidly tamped with the proper tools so as not to injure, damage, or disturb the pipe. Backfilling shall be carried on simultaneously on each side of the pipe to assure proper protection of the pipe.

Each lift shall be "walked in" and supplemented by slicing with a shovel to ensure that all voids around the pipe have been completely filled. Mechanical compaction such as "pogo sticks" or "wackers", as approved, shall be used for compaction of pipe zone.

- B. Initial Backfill - The remaining portion of the trench shall be backfilled, compacted and/or consolidated by approved methods to obtain a 90% compaction as measured by Test Method 231 F. Backfill shall be good sound earth, sand or gravel. Bituminous pavement, concrete, rock, or other lumpy material shall not be used in the backfill unless these materials are scattered and do not exceed 6 inches in any dimension and are not placed within 1 ½ feet of the surface. Material of perishable, organic matter, spongy or otherwise improper nature, shall not be used.

When backfill is placed mechanically, the backfill material shall be pushed onto the slope of the backfill previously placed and allowed to slide down into the trench. The contractor shall not push backfill into the trench in such a way as to permit free fall of the material until at least 18 inches of cover is provided over the top of the pipe. Under no circumstances shall sharp, heavy pieces of materials be allowed to be dropped directly onto the pipe or the tamped material

around the pipe. Backfill shall be placed in layers not exceeding eight inches and compacted by an approved method.

Heavy duty compacting equipment having an overall weight in excess of 125 pounds shall not be used until backfill has been completed to a depth of 2 feet over the top of the pipe.

If hydro-hammer is used for compaction of overlying materials, at least four feet of backfill must be placed over the top of pipe prior to its use. This is required to insure that the pipe is not damaged.

- C. Final Backfill - Final backfill placed in trenches below roadways or below shoulders of roadways, shall be compacted to a density of not less than 95% or as directed by the encroachment permit. Backfill outside of roadways shall be compacted to 90%.

Backfill shall be placed in layers not exceeding eight inches, compacted and brought up to the sub grade of the roadway.

- 3.4 Excess Excavated Material - The contractor shall make the necessary arrangements for, and shall remove and dispose of all excess excavated material. It is the intent of these specifications that all surplus material not required for backfill or fill shall be disposed of by the contractor outside the limits of the public right-of-way and/ or easements at no liability to the District.

No excavated material shall be deposited on private property unless written permission from the owner thereof is secured by the contractor. Before the District will accept the work as being completed, the contractor shall file a written release signed by all property owners with whom he has entered into agreements for disposal of excess excavated material absolving the District from any liability connected therewith.

- 3.5 Restoration of Damaged Surfaces and Property - If any pavement, trees, shrubbery, fences, poles or other property and surface structures have been damaged, removed, or disturbed by the contractor, whether deliberately or through failure to carry out the requirements of the contract documents, state laws, municipal ordinances, or the specific direction of the District, or through failure to employ usual and reasonable safeguards, such property and surface structures shall be replaced or repaired at the expense of the contractor.

- 3.6 Final Clean-Up - After backfill has been completed, the right-of-way shall be dressed smooth and left in a neat and presentable condition to the satisfaction of the District.

END OF SECTION

STEEL PIPE CASING AND BORING

1.0 GENERAL

- 1.1 Scope - This specification governs the furnishing and installing of carrier pipe and casing to a true line and grade as shown on the plans to be bored and jacked by auger without disturbing the surface. All incidentals and appurtenant operations necessary for the construction of the casing and pipe shall be done in strict accordance with the drawings, applicable permits, and other terms and conditions of the contract. Should there be conflicts between this specification and the governing agency, the more restrictive condition shall apply.

The contractor shall furnish all equipment, tools, labor and materials required for the construction as shown and specified.

All standard specifications, i.e., AWWA, ASTM, etc., made a portion of these specifications by reference, shall be the latest edition and revision thereof.

The contractor shall be responsible for all material furnished by him and shall replace at his own expense, should the material be defective in manufacture or damaged in delivery. This shall include the furnishing of all material and labor required to replace defective material discovered prior to final acceptance of the work.

- 1.2 Submittals - Submittals shall be provided for the following items:

- Casing, size, thickness, and material
- Construction method
- Skid configuration
- Pit bracing
- Carrier pipe type

- 1.3 Permits - All work shall conform to the specifications and requirements of the agency having jurisdiction. The contractor shall secure all required permits for construction of casing pipe installation.

- 1.4 Safety - It shall be the contractor's responsibility to see that the work is done in conformance with Cal-OSHA and all other applicable laws and regulations.

2.0 MATERIALS

- 2.1 Casing - Steel casing pipe shall conform, as a minimum, to ASTM A283, Grade C. All casing is required to be either straight seam or seamless steel. Used pipe for casing shall be allowed if it meets the same specifications as new pipe that is used for casing.

Minimum wall thickness for steel pipe casing shall be as shown on the table that follows the casing specifications. However, in no case shall wall thickness be less than 1/4-inch.

Lap weld or corrugated pipe, shall not be used for boring.

All casing length shall be equal to the auger length.

- 2.2 A. Tolerances for Casing - The outside diameter (O.D.) shall be as follows:

- 4 1/2 inches O.D. through 18 inches O.D. ±0.75%
- 20 inches O.D. and larger ±1.00%

For casing used in any one bore, maximum variation within above tolerances between maximum and minimum outside diameter shall not exceed 1/4-inch from 6 inches to 48 inches and 1/2-inch over 54 inches.

The wall thickness at any and all places on steel casing shall be as follows:

- 4 inches through 18 inches +15.0% -12.0%
- 20 inches and larger +17.5% -10.0%

- B. Lengths and Ends - Unless otherwise agreed, the casing shall be square cut by mechanical methods. Torches held by machinery shall be considered to meet this requirement. The lengths shall be even multiples of 10 feet (i.e. 10 feet, 20 feet, 30 feet, 40 feet, etc.) unless otherwise specified by the boring contractor. This does not apply to field cutting.

- C. Straightness - Casing shall be measured by the cord method with either string or wire stretched taut to take out all visible sag. Maximum cord measured along the casing shall be true length x0.02%. This shall be measured on actual lengths before loading for delivery to the jobsite.

D. Minimum Wall Thickness for Casing - If not shown on the plans, the minimum wall thickness shall be as follows:

<u>Casing Size</u>	<u>0 to 100' Length</u>	<u>100' to 200' Length</u>
16"-18"	1/4"	3/8"
20"-26"	5/16"	5/16"
28"-32"	3/8"	3/8"

E. Lead Joint - The lead joint, where called for, shall be 10 feet long and 1 ½ times the wall thickness of the casing being used.

F. Grout Ports - For casing sizes 30 inches and larger, inside grout ports shall be provided. Location and frequency of the ports shall be approved by the engineer.

2.3 Grout - Grout shall consist of one part Portland cement, water, and four parts sand. Sand shall be of a fineness that 100% passes a standard 8-mesh sieve and at least 45%, by weight, passes the 40-mesh sieve.

2.4 Carrier Pipe - Carrier pipe shall be either ductile iron pipe or polyvinyl chloride (PVC) conforming to the applicable pipe technical specification.

2.5 Skids - Skids shall be pressure treated fir, heart redwood, or polyurethane. Skid straps shall be stainless steel.

2.6 Backfill - The void between the earner pipe and casing shall be filled with blown sand or grout as shown on the plans.

3.0 EXECUTION

3.1 Bore and Receiving Pits - The trench for boring operations shall be adequately shored to safeguard existing substructures and surface improvements and to ensure against ground movement in the vicinity of the casing portal.

The foundation of the approach pit shall be prepared to provide firm support for the guide rails and boring machinery. Pits shall be of sufficient size to allow free insert of the lengths of casing pipe. All rails and support members shall be anchored to ensure that the action of the jacks is in line with the axis of the casing.

All pits shall be fenced and/or a type "K" barrier placed for protection. Pits to be left open overnight shall have a six-foot high fence, in panel sections, securely fastened together for predesign safety. Reflectors shall be secured to the side of the fence that faces traffic.

- 3.2 Alignment and Grade - Where tolerances are not shown on the plans, the horizontal tolerance for pressure and gravity pipeline shall be 1% left or right, from the survey line.

Vertical tolerance for pressure pipelines shall be 1% up or down from the grade line. No vertical tolerance is allowed for gravity flow pipelines.

- 3.3 Boring - Casing sections shall be joined by full-circumference butt welding in the field. The contractor shall prepare ends of casings for welding by providing a ¼-inch x 45 degree chamfer on the ends to be welded.

The end of the steel casing pipe shall be kept immediately behind the cutterhead of the boring machine. The bored hole shall have a diameter no greater than 1 inch larger than the steel casing pipe.

- 3.4 Grouting - Immediately after completion of the jacking or boring operation, lean grout shall be injected through the grout connections of casings 30 inches and larger in a manner that will completely fill all voids outside the casing pipe resulting from the boring operation. Grout pressure is to be controlled so as to avoid deformation of the casing and/or movement of the surrounding ground. After completion of grouting, the grout connections shall be closed with cast-iron threaded plugs.

Voids, created by casings smaller than 30 inches, shall be grouted from ground surface.

- 3.5 Carrier Pipe Installation - The carrier pipe shall be pushed into the casing pipe using skids in accordance with the detail.

It shall be the responsibility of the contractor to secure the carrier pipe in a manner satisfactory to the District Representative to prevent "floating" and subsequent loss of grade when the annular space between the casing pipe and the carrier pipe is filled.

Before backfilling the annular space, the carrier pipe shall pass an initial pressure or leakage test.

- 3.6 Backfill - The annular space between the carrier pipe and the jacked casing shall be filled with air blown sand.

- 3.7 Sealing Ends of the Casing - The annular spaces at the ends of the casing shall be sealed with Class B concrete a minimum of six inches thick or brick and mortar.

- 3.8 Closing the Jacking Pit - After jacking equipment and muck from the tunnel have been removed from the approach trench of the jacking pit, the

contractor shall prepare the bottom of the jacking pit as a pipe foundation. Loose and disturbed material below pipe grade to undisturbed earth shall be removed and then replaced and compacted in eight-inch lifts.

END OF SECTION

SEWER SYSTEM TESTING

1.0 GENERAL

- 1.1 Scope - This section governs the testing requirements and procedures for acceptance of all completed sewer lines, manholes, and force mains.

It is the intent of the plans and specifications that the completed sewer pipes along with manholes and other appurtenances shall be watertight.

All sewer pipes shall be air tested for leakage. Gravity sewer mains, including services, shall also be visually inspected by video camera and tested for deflection by a mandrel. Manholes shall be hydrostatically tested for infiltration.

All tests shall be made in the presence of the District.

Even though a section may have previously passed the leakage test, each section of sewer shall be tested subsequent to the last backfill compacting operation if, in the opinion of the District heavy compaction equipment or any of the operations of the contractor or others may have damaged or affected the structural integrity or water tightness of the pipe, structure, and appurtenances.

OFFICIAL DISTRICT TESTING WILL NOT BE PERMITTED UNTIL AFTER ALL OTHER UNDERGROUND FACILITIES HAVE BEEN INSTALLED AND THEIR TRENCH COMPACTION VERIFIED.

When lines to be tested are in areas that will be paved, testing shall be done after the rock subgrade is placed and compacted.

- 1.2 Acceptance - The sewer will not be considered acceptable until the leakage or infiltration rate, as determined by test, is less than the maximum allowable.

If the leakage or infiltration rate is greater than the amount specified, the pipe joints shall be repaired or, if necessary, the pipe shall be removed and relayed by the contractors, and retested.

- 1.3 Submittals - The contractor shall notify the District a minimum of 3 business days in advance of its proposed testing schedule for review and concurrence.

2.0 MATERIALS

- 2.1 General - All test equipment, valves, plugs, or other control equipment and materials shall be determined and furnished by the contractor, subject to District review. No materials shall be used which would be injurious to the construction or its future function.

3.0 EXECUTION

- 3.1 Mandrel Test for Gravity Sewers - After completion of the sewer line, the line shall be ball flushed just prior to pulling the mandrel through.

A commercially manufactured, rigid, odd-numbered leg (9 legs minimum) mandrel, with a circular cross section having a diameter of at least 95% of the specified average inside diameter, shall be pulled through the pipe by hand. The minimum length of the mandrel shall be equal to the base inside diameter of the pipe. Obstructions encountered by the mandrel shall be corrected by the contractor.

- 3.2 Air Test for Gravity Sewers - After the mandrel test, each section of sewer between successive manholes shall be air tested as follows:

- A. With all outlets plugged, air shall be slowly added until the internal pressure is raised to 4.0 pounds per square inch gage (psig). The compressor used to add air to the pipe shall have a relief valve set at 5 psig to ensure that at no time the internal pressure in the pipe exceeds 5 psig.
- B. The internal pressure of 4 psig shall be maintained for at least two minutes to allow the air temperature to stabilize, after which the air supply shall be disconnected and the pressure allowed to decrease to 3.5 psig.
- C. The time in minutes that is required for the internal air pressure to drop from 3.5 psig to 3.0 psig shall be measured. The results shall not be less than the minimum permissible duration for the air test pressure drop shown in Table I.

TABLE I
MINIMUM TIME FOR
AIR PRESSURE DROP OF 0.5 PSIG

Pipe Diameter (in.)	Time for Length Shown (in Minutes/Seconds)				
	0-200'	201-250'	251-300'	301-350'	351-400'
6	2:50	2:50	2:50	2:50	2:50
8	3:50	3:50	3:50	4:30	5:00
10	4:40	5:00	6:00	7:00	7:50
12	5:40	7:10	8:30	10:00	11:20

- D. Should groundwater be present above the flowline of the pipe, the air pressure added to the 3.5 psig criteria shall be calculated by dividing the vertical height, in feet of groundwater above the flowline, by 2.31. The starting test pressure shall not exceed 9.0 psig.
- E. If the time shown in Table I for the designated pipe size and length elapses before the air pressure drops 0.5 psig; the section being tested shall have passed and the test discontinued.

3.3 Manhole Test - Water tightness of manholes may be tested in connection with tests of sanitary sewers or at the time the manhole is completed and backfilled. The test shall be as follows:

- A. The contractor shall plug all inlets and outlets with approved stoppers or plugs.
- B. The manhole shall be filled with water to the top of the frame.
- C. The water shall stand in the manhole for a minimum of one hour to allow the manhole material to reach maximum absorption.
- D. The contractor shall refill the manhole to the original depth.
- E. The time of the test will be determined by the District to fit the various field conditions.
- F. The manhole shall be refilled to the original depth and the amount of water required to fill the manhole shall be recorded.
- G. If the amount of water added does not exceed the limits shown in Table II, then the manhole has passed the test.

TABLE II

<u>Depth of Manhole (ft.)</u>	<u>Allowable Amount of water added (gal.)</u>
0-5	1
6-7	1-1/2
8-10	2
11-12	2-1/2
13-15	3
16-18	3-1/2
19-20	4

- H. Even though the leakage may be less than the specified amount, the contractor shall stop any leaks that may be observed to the satisfaction of the District.
- I. For manholes that require lining the inlet(s) and outlet shall be mandrel tested after the lining is applied to verify flowline has not been compromised.

3.4 Video Test- All sewer collectors and laterals shall be T.V. inspected prior to pavement placement in accordance to the following:

- A. The complete job is ready for television inspection when the following work has been completed and approved by the District:
 1. All sewer pipelines are installed, backfilled, and compacted.
 2. All manholes are in place, all channeling is complete and pipelines are accessible from manholes, and testing completed.
 3. All other underground facilities, utility piping and conduits are installed.
 4. Final sub grade is complete. For wet weather periods, placement of aggregate base has been completed.
 5. Pipelines to be inspected have been cleaned and flushed per Section 3.1.
 6. Final air test has been completed per Section 3.2.
- B. After the above work is complete, the contractor shall schedule the video inspection. The video test shall be done in the presence of the District's inspector. Water is to flow through the lines for 12

hours prior to the T.V. work. During the video for service, some water must be flowing for camera orientation. The camera shall have a device to measure depths.

- C. If no deficiencies are observed, the work will be considered satisfactory.
- D. A videotape will be made .and given to the District, and defects serious enough to require correction will be determined by the District.
- E. Notification will be made in writing of any deficiencies revealed by the video that will require repair. If corrective work is indicated and viewing of the videotapes is desired, the District shall be contacted to set a time for the viewing with the Engineer.
- F. Corrective work shall be done. District reserves the right to require another test of any repair.
- G. Those portions of the pipeline system that have been corrected will be re-inspected.
- H. The following observations from television inspections will be considered defects in the construction of sewer pipelines and will require correction prior to paving:
 - 1. Low spots, 1/2-inch and greater
 - 2. Joint separations
 - 3. Cocked joints present in straight runs or on the wrong side of pipe curves
 - 4. Cracked or damaged pipe
 - 5. Dropped joints
 - 6. Infiltration
 - 7. Debris or other foreign objects
 - 8. Other obvious deficiencies
 - 9. Irregular condition without logical explanation
 - 10. Standing water in service laterals

- 3.5 Sewer Force Main Test - Leakage test for sewer force mains shall follow the procedures set forth in Technical Specification 33 13 00 "Testing and Disinfecting Water Mains" Subsection 3.2.

All defective elements shall be repaired, or removed and replaced, and then retested until all visible leakage has been stopped and the allowable leakage requirements have been met.

END OF SECTION

ABANDONMENT OF FACILITIES

1.0 GENERAL

- 1.1 Scope - This section governs abandonment of pipelines, manholes, vaults, and other existing structures.
- 1.2 Submittals - Upon request, schedules and method of abandonment shall be submitted to the District for approval.

2.0 MATERIALS

- 2.1 General - Concrete, fittings, backfill material and other material used for abandonment shall comply with District Technical Specifications.

3.0 EXECUTION

- 3.1 Pipelines - Pipelines are to be abandoned by either plugging the ends or filling the entire pipeline with pumped concrete.

Pipelines to be abandoned, shall be securely closed at all pipe ends by an approved cap or, at manhole entries, by a watertight plug of concrete, or brick and cement mortar, not less than 2-feet thick. When laterals are abandoned, they shall be capped with an approved fitting at the property line.

Pipelines to be completely filled shall be pumped full with a concrete mix sufficiently workable for the purposes intended.

- 3.2 Structures - Structures to be abandoned shall have all openings, inlets and outlets sealed off and the structure shall be removed to a point 3 feet below the proposed street grade or ground surface and filled with backfill (compacted as directed) or concrete.
- 3.3 Salvaged Materials - Salvaged castings such as frames and covers and other appurtenances, unless otherwise specified, shall be delivered to a District facility prearranged with the Maintenance' Supervisor.

END OF SECTION

DUCTILE IRON PIPE AND FITTINGS
(PRESSURE FLOW) (UNDERGROUND)

1.0 GENERAL

- 1.1 Scope - This specification governs the furnishing and installation of ductile iron pipe material and main line fittings including laying, joining, bedding and approvals. All incidentals and appurtenant operations necessary for the construction of pipelines shall be accomplished in strict accordance with the drawings and other terms and conditions of the contract.

Fitting types covered under this section include bends, tees, crosses, reducers, couplings, caps, plugs, adapters and all other fittings necessary for a complete pipeline installation.

The contractor shall also furnish all equipment, tools, labor and materials required to relocate sewers, conduits, ducts, pipes, or other structures as may be necessary to complete the installation as shown and specified.

All standard specifications, i.e., AWWA, ASTM, etc., made a portion of these specifications by reference, shall be the latest edition and revision thereof.

The contractor shall be responsible for all material furnished by him, and shall replace, at his own expense, all material found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include the furnishings of all material and labor required to replace defective material discovered prior to final acceptance of the work.

The contractor shall be responsible for the safe storage of material until it has been incorporated into the completed project. The interior of all pipe and fittings shall be kept free from dirt and foreign matter at all times.

Pipe surfaces shall be free from nicks, scratches and other blemishes. The joining surfaces of pipe spigots and bell sockets shall be free from gouges or other imperfections that might cause leakage.

- 1.2 Submittals - Submittals shall be provided for the following items plus all additional items required in the specifications for the particular type of pipe:

- Pipe and joint material
- Fittings
- Specialties

2.0 MATERIALS

2.1 Ductile Iron Pipe (DI) - Ductile iron pipe shall conform to the quality and strength requirements of AWWA C-151.

A. Markings - Each standard or random length of pipe shall be clearly marked with the following:

- The letters "DI" or "Ductile"
- Nominal size and class
- Year produced
- Manufacturer's trade name and country where cast
- Seal (mark) of testing agency

B. Pressure Class - Where the class is not indicated on the plans, the pipe shall be Class 350.

C. Laying Length - Standard laying lengths of 18- or 20-foot is acceptable.

D. Joint Type - Unless otherwise shown or specified, pipe joints shall be rubber gasket push-on type joint conforming to AWWA C-111.

1. Flanged Joint - Where flanged joints are specified, pipe barrel shall be threaded and fitted with flanges in accordance to AWWA C-115 "Flanged Ductile Iron Pipe with Threaded Flanges."

E. Physical Test Requirements - Hydrostatic, tension test, and impact test shall be conducted at the factory in accordance with ASTM A746. All testing shall be performed by a recognized testing laboratory with such testing available for inspection by the District. If required, the manufacturer shall supply a letter of certification attesting to their pipe meeting these specifications.

F. Lining and Coating - The inside surfaces shall be cement mortar lined in accordance with ANSI/AWWA C-104/A21.4. The outside coating shall be an asphaltic coating per AWWA C-151.

G. Polyethylene Encasement - Pipe and fittings shall be wrapped in polyethylene. Polyethylene wrapping shall be in accordance to AWWA C-105, latest revision. Minimum thickness shall be 0.008 inch (8 mils).

H. Warning Tape - Two-inch-wide non-metallic tape marked "waterline."

2.2 Fittings - All cast and ductile iron fittings shall be manufactured in accordance with the following AWWA Standards: C-104, "Cement-Mortar Lining for Ductile-Iron Pipe and Gray-Iron and Fittings for Water", C-110, "Gray-Iron and Ductile-Iron Fittings, 3 inches through 48 inches for Water and Other Liquids", C-111, "Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings", with the following additional requirements or exceptions. All fittings shall be furnished with a cement-mortar lining of standard thickness as defined in referenced specifications.

All fittings shall be rated equally to the class of pipe. End connections may be push-on, mechanical, or flanged joints.

Ductile iron compact fittings, per AWWA C-153, are allowed.

A. Flanges. Bolts and Gaskets - Flanges shall be flat-faced and meet either the requirements of AWWA C-207 for steel hub flange fittings, or AWWA C-110 Section 10-18 for ductile iron fittings. The flanges shall be marked with the size, name or trademark of manufacturer and with the AWWA Class; i.e., "E", or pressure rating.

Bolts and nuts shall be cadmium plated, A307, Grade B of domestic origin. Cadmium plating shall conform to Federal Specification QQ-P-415-1956, Type 1, Class 1.

Gaskets shall be 1/8-inch thick and be of the full-face self-centered cloth impregnated type. The following table shows the bolt pattern for ASME/ANSI 16.1 Class 125 cast iron flange. This pattern is rated at 275 psi for Class E steel pipe flanges and 250 psi for ductile iron pipe fittings.

<u>Pipe Size</u>	<u>Bolt Hole Diameter (Inches)</u>	<u>Bolt Diameter & Length (Inches)</u>	<u>Number of Bolts</u>
6"	7/8	3/4 x 3 1/2	8
8"	7/8	3/4 x 3 1/2	8
10"	1	7/8 x 4	12
12"	1	7/8 x 4	12
14"	1 1/8	1 x 4 1/2	12
16"	1 1/8	1 x 4 1/2	16
18"	1 1/4	1 1/8 x 5	16

The contractor shall uniformly tighten the bolts and prevent bending or torsional strains. Proper anchorage shall be provided.

- B. Mechanical Joint Fittings - The mechanical joints shall meet AWWA C111. That standard covers the joint as well as gaskets and bolts. T-bolts and nuts shall be manufactured of corrosion-resistant high-strength low-alloy Cor-Ten steel or equal. Number and length of bolts shall be as follows:

<u>Pipe Size</u>	<u>Number of Bolts</u>	<u>Bolt Diameter & Length (Inches)</u>
6"	6	3/4 x 3 1/2
8"	6	3/4 x 4
10"	8	3/4 x 4
12"	8	3/4 x 4
14"	10	3/4 x 4
16"	12	3/4 x 4 1/2
18"	12	3/4 x 4 1/2

- C. Restrained Joints - Restrained joint pipe and fittings shall be U.S. Pipe TR FLEX or approved equal.

- D. Coatings and Linings - Cast iron fittings shall be cement mortar lined per AWWA C-104 and receive a bituminous coating per AWWA C110.

Threaded holes and mating surfaces shall not be coated. Flange faces shall be coated with asphaltic varnish only. There shall be no coating of materials, or mortar on gasket grooves.

- E. Mechanical Couplings - Couplings include transition couplings, flanged coupling adapters, flexible and insulated couplings.

1. Coupling Sleeves and Flanges - Coupling sleeves and flanges may be of gray iron or carbon steel.
2. Bolts and Nuts for Flanges - Bolts and nuts for buried and submerged flanges, flanges in underground vaults and structures, and flanges located outdoors above ground shall be cadmium plated, A307, Grade B. Provide one washer for each nut. Each washer shall be of the same material as the nut.

3.0 EXECUTION

- 3.1 Handling and Transportation - Handling and transportation of pipe shall be in accordance with the pipe manufacturer's published instructions.

Heavy canvas or nylon slings of suitable strength shall be used for lifting and supporting materials. Chains or cables shall not be used.

Pipe and fittings shall not be stored on rocks or gravel, or other hard material which might damage the pipe.

A. Rubber Gasket Storage - All rubber gaskets shall be stored in a cool, well ventilated place and not exposed to the direct rays of the sun. Gaskets shall not be allowed in contact with oils, fuels, petroleum, or solvents.

3.2 Pipe Laying - Pipe shall be laid in accordance with the pipe manufacturer's published instructions, as complimented and modified herein.

A. Cleanliness - The interior of pipes shall be clean of foreign materials before sections of pipe are installed and shall be protected to prevent entry of foreign materials after installation.

Open ends of installed pipe shall be sealed with watertight plugs or other approved means at times when pipe installation is not in progress.

Ground water shall not be allowed to enter the pipe.

B. Inspection Before Installation - All pipe and fittings shall be carefully examined for cracks and other defects while suspended and before installation. Spigot ends shall be examined with particular care as this area is the most vulnerable to damage from handling. Defective pipe or fittings shall be laid aside for inspection by the District, who will prescribe corrective repairs or rejection.

C. Lowering of Pipe Material into Trench - Proper implements, tools, and equipment, satisfactory to the District, shall be provided and used by the contractor for the safe and convenient performance of the work. All pipe, fittings, valves, and hydrants shall be carefully lowered into the trench piece by piece in such a manner as to prevent damage to the water main materials and protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench.

If damage occurs to any pipe, fittings, valves, hydrants or water main accessories in handling, the damage shall be immediately brought to the District's attention.

D. Laying of Pipe - Pipe shall be laid in trenches to the line and grade indicated on the plans and as specified.

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. If the pipe laying crew cannot install the pipe into the trench without getting earth into it, the District's Inspector may require a heavy tightly woven canvas bag of suitable size, or plastic caps, be placed over each end of the pipe prior to installation and left there until the connection is made to the adjacent pipe. During laying operations, no debris, tools, clothing or other material shall be placed in the pipe.

As each length of pipe is placed in the trench, the spigot end shall be centered in the bell or coupling, and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material tamped under it, except at the bells or couplings. Precautions shall be taken to prevent dirt from entering the joint space.

Joints shall be assembled in accordance with the manufacturer's instructions. Each joint shall be checked with a feeler gauge to assure proper seating of the gasket.

- E. Cutting of Pipe - Field cuts and connections shall be in accordance with the pipe manufacturer's published instructions.

The cutting of pipe for inserting valves, fittings, or closure pieces, shall be done in a neat and workmanlike manner without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe.

- F. Allowable Deflection - The maximum allowable angular deflection at the joints shall be 80% of manufacturer's recommendation for push-on and mechanical joints.

3.3 Fittings - Fittings shall be installed in the manner specified herein.

- A. Anchorage for Fittings - All fittings shall be provided with a thrust block constructed against undisturbed soil as shown on the Standard Drawings.

- B. Thrust Blocks - Thrust blocks shall be constructed of Class B concrete. Care shall be taken not to obstruct the outlets of tees or crosses, which are intended for future connections. A waterproof paper or plastic bond-breaker shall be placed between plugs and caps and the concrete thrust block to facilitate their removal in the future. Thrust blocks shall be poured against undisturbed earth and

shall have at least the minimum dimensions shown in the details on the Standard Drawings.

- C. Mechanical Couplings - Oil, scale, rust, and dirt shall be cleaned from pipe ends. The contractor shall clean gaskets in couplings prior to installing the coupling in accordance with the manufacturer's recommendations.

Bolt threads shall be lubricated with graphite and oil prior to installation.

1. Painting and Coating

- a. The contractor shall coat buried flexible pipe couplings, transition couplings, and flanged coupling adapters per Section 09 90 00 and then wrap the couplings with polyethylene wrap per AWWA C-105.
- b. The contractor shall coat flexible pipe couplings (including joint harness assemblies), transition couplings, and flanged coupling adapters located indoors, in vaults and structures, and above-ground with the same coating system as specified for the adjacent pipe. A prime coat shall be applied at the factory.

- 3.4 Polyethylene Encasement - The polyethylene encasement shall prevent contact between the pipe and the surrounding backfill and bedding materials, but is not intended to be a completely airtight or watertight enclosure. All lumps of clay, mud, cinders, etc. on the pipe surface shall be removed prior to installation of the polyethylene encasement. During installation, care shall be exercised to prevent soil or embedment material from becoming trapped between the pipe and the polyethylene.

The polyethylene film shall be fitted to the contour of the pipe to effect a snug, but not tight, encasement with a minimum space between the polyethylene and the pipe. Sufficient slack shall be provided in contouring to prevent stretching the polyethylene where it bridges irregular surfaces, such as bell-spigot interfaces, bolted joints, or fittings, and to prevent damage to the polyethylene due to backfilling operations. Overlaps and ends shall be secured with adhesive tape.

For installations below the water table, both ends of the polyethylene tube shall be sealed as thoroughly as possible with adhesive tape at the joint overlap.

Installation of polyethylene encasement shall be in accordance with the Standard Drawings and AWWA C-105, Method A. The following summarizes this method.

- A. Installation of Polyethylene Encasement for Pipe - Cut polyethylene tube to a length approximately two feet longer than the pipe section. Slip the tube around the pipe, centering it to provide a one-foot overlap on each adjacent pipe section, and bunching it accordion fashion lengthwise until it clears the pipe ends.

Lower the pipe into the trench and make up the pipe joint with the preceding section of pipe. A shallow bell hole must be made at the joints to facilitate installation of the polyethylene tube.

After assembling the pipe joint, make the overlap of the polyethylene tube. Pull the bunched polyethylene from the preceding length of pipe, slip it over the end of the new length of pipe, and secure it in place. Then slip the end of the polyethylene from the new pipe section over the end of the first wrap until it overlaps the joint at the end of the preceding length of pipe. Secure the overlap in place. Take up the slack width at the top of the pipe to make a snug, but not tight, fit along the barrel of the pipe, securing the fold at quarter points.

Any cuts, tears, punctures, or other damage to the polyethylene, shall be repaired as described below. Proceed with installation of the next section of pipe in the same manner.

- B. Installation of Polyethylene Encasement for Appurtenances - Cover bends, reducers, offsets, and other pipe-shaped appurtenances with polyethylene in the same manner as the pipe. When it is not practical to wrap tees, crosses, and other odd-shaped pieces in a tube, the items shall be wrapped with a flat sheet or split length of polyethylene tube by passing the sheet under the appurtenance and bringing it up around the body. Seams shall be made by bringing the edges together, folding over twice, and taping down. Polyethylene shall be taped securely in place.
- C. Repairs of Polyethylene Encasement - Repair any cuts, tears, punctures, or damage to polyethylene with adhesive tape, or with a short length of polyethylene sheet or a tube cut open, wrapped around the pipe to cover the damaged area, and secured in place.
- D. Openings in Polyethylene Encasement - Provide openings for branches, service taps, blowoffs, air valves, and similar appurtenances by making an X-shaped cut in the polyethylene and

temporarily folding back the fill. After the appurtenance is installed, tape the slack securely to the appurtenance and repair the cut, as well as, any other damaged areas in the polyethylene, with any resulting damaged areas being repaired, as described above.

- E. Junctions with Unwrapped Pipe - Where polyethylene-wrapped pipe joins an adjacent pipe that is not wrapped, extend the polyethylene wrap, to cover the adjacent pipe for a distance of at least three feet away from the ductile iron pipe. Service lines of dissimilar metals shall be wrapped with polyethylene or a suitable dielectric tape for a minimum clear distance of three feet away from the ductile iron pipe.

- 3.5 Testing and Disinfection - Testing and disinfection shall be performed on all pipelines, in accordance with Section 33 13 00.

END OF SECTION

POLYVINYL CHLORIDE PIPE AND FITTINGS (PVC)
(PRESSURE FLOW)

1.0 GENERAL

- 1.1 Scope - This specification governs the furnishing and installation of PVC pipe material and main line fittings including laying, jointing, bedding, and approvals. All incidentals and appurtenant operations necessary for the construction of water mains shall be done in strict accordance with the drawings and other terms and conditions of the contract. Fitting types covered under this section include bends, tees, crosses, reducers, couplings, caps, plugs, adapters and all other fittings necessary for a complete pipeline installation.

The contractor shall also furnish all equipment, tools, labor and materials required to relocate sewers, conduits, ducts, pipes, or other structures as may be necessary to complete the installation as shown and specified.

All standard specifications; i.e., AWWA, ASTM, etc., made a portion of these specifications by reference shall be the latest edition and revision thereof.

The contractor shall be responsible for all material furnished by him and shall replace at his own expense, all material found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include the furnishings of all material and labor required to replace defective material discovered prior to final acceptance of the work.

Pipe surfaces shall be free from nicks, scratches and other blemishes. The joining surfaces of pipe spigots and of integral bell and sleeve reinforced bell sockets shall be free from gouges or other imperfections that might cause leakage.

- 1.2 Storage and Care - The contractor shall be responsible for the safe storage of material until it has been incorporated into the completed project. The interior of all pipe and fittings shall be kept, free from dirt and foreign matter at all times.

Pipe shall be stored at the job site in unit packages provided by the manufacturer. Caution shall be exercised to avoid compression, damage or deformation to bell ends of the pipe. If pipe is to be exposed to direct sunlight for more than 14 days, pipe must be covered with an opaque material while permitting adequate air circulation above and around the pipe to prevent excessive heat accumulation. Gaskets shall be protected

from excessive exposure to heat, direct sunlight, ozone, oil and grease. Solvent cement when used shall be stored in tightly sealed containers from excessive heat.

1.3 Submittals - Submittals shall be provided for the following items plus all additional items required in the specifications for the particular type of pipe:

1. Pipe and jointing material
2. Fittings
3. Specialties

2.0 MATERIALS

2.1 Polyvinyl Chloride Pipe (PVC) - PVC pipe shall conform to AWWA C-900, titled "Polyvinyl Chloride Pipe (PVC) Pressure Pipe 4 Inches through 12 Inches for Water" and shall have the same outside diameter (O.D.) as that of cast iron pipe (C.I.P.O.D.) in the sizes furnished.

A. Markings - Each standard or random length of pipe shall be clearly marked with the following:

- Nominal size and O.D. base; i.e., six-inch cast iron pipe size
- Material code "PVC 1120"
- Dimensional ratio; i.e., DR 18 where DR is equal to thickness "divided by" diameter
- AWWA pressure class; i.e., PC 150
- AWWA designation "AWWA C-900"
- Manufacturer's trade name and production record code
- Seal (mark) of testing agency

B. Pressure Class - Where the class is not indicated on the plans, the pipe shall be Class 150.

C. Laying Length - The standard laying length shall be 20 feet (plus or minus 1 inch) in all classes. A maximum of 15% may be furnished in random lengths of not less than 10 feet each.

D. Joint Type - Pipe joints shall be made using an integral bell with an elastomeric gasket push-on type joint or using machined couplings of a sleeve type with rubber ring gaskets and machined pipe ends to form a push-on type joint.

Solvent cement joints are strictly prohibited.

One coupling complete with one gasket each shall be factory assembled to each length of standard length pipe furnished. The companion gasket for each coupling will be packaged separately for shipment. Couplings shall be the same class as the pipe. Manufacturer shall furnish gasket lubricant for each quantity of pipe furnished. When additional couplings are furnished as separate items, two gaskets shall be furnished and installed in the gasket recess of each coupling.

1. Couplings - Where couplings are used, they shall meet the requirements of AWWA C-900. Couplings shall be as furnished by the manufacturer. Couplings shall be marked with same information as the pipe.

E. Physical Test Requirements - Hydrostatic burst and sustained pressure and crushing tests shall be conducted at the factory in accordance with AWWA C-900. All testing shall be subject to inspection by the District. If required, the manufacturer shall supply a letter of certification attesting to their pipe meeting these specifications.

F. Locating Wire - Locating wire shall be single strand, 10-gauge copper wire, with solid thermoplastic insulation.

G. Warning Tape - Warning tape shall be two-inch-wide non-metallic tape marked "waterline."

2.2 Fittings - All cast and ductile iron fittings shall be manufactured in accordance with the following AWWA Standards: C104, "Cement-Mortar Lining for Ductile-Iron Pipe and Gray-Iron and Fittings for Water," C110, "Gray-Iron and Ductile-Iron Fittings, 3 Inches through 48 Inches for Water and Other Liquids". C111, "Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings," with the following additional requirements or exceptions. All fittings shall be furnished with a cement-mortar lining of standard thickness as defined in referenced specifications.

All fittings shall be rated equally to the class of pipe. End connections may be push-on, mechanical, or flanged joints except where specifically shown otherwise on the plans or Standard Drawings.

Ductile iron compact fittings, per AWWA C153, are allowed.

A. Flanges, Bolts and Gaskets - Flanges shall be flat-faced and meet either the requirements of AWWA C-207 for steel hub type flange fittings, or AWWA C-110 Section 10-18 for ductile iron fittings. The flanges shall be marked with the size, name or trademark of the

manufacturer and with the AWWA Class; i.e., "E", or pressure rating.

Bolts and nuts shall be cadmium plated, A307, Grade B of domestic origin.

Cadmium plating shall conform to Federal Specification QQ-P-415-1956, Type 1, Class 1.

Gaskets shall be 1/8-inch thick and be of the full face self centered cloth impregnated type. The following table shows the bolt pattern for ASME/ANSI 16.1 Class 125 cast iron flange. This pattern is rated at 275 psi for Class E steel pipe flanges and 250 psi for ductile iron pipe fittings.

<u>Bolt Hole Pipe Size</u>	<u>Diameter (Inches)</u>	<u>Bolt Diameter & Length (Inches)</u>	<u>Number of Bolts</u>
6"	7/8	3/4 x 3 1/2	8
8"	7/8	3/4 x 3 1/2	8
10"	1	7/8 x 4	12
12"	1	7/8 x 4	12
14"	1 1/8	1 x 4 1/2	12
16"	1 1/8	1 x 4 1/2	16
18"	1 1/4	1 1/8 x 5	16

The contractor shall uniformly tighten the bolts and prevent bending or torsional strains. Proper anchorage shall be provided.

- B. Mechanical Joint Fittings - The mechanical joints shall meet AWWA C111. That standard covers the joint as well as gaskets and bolts.

T-bolts and nuts shall be manufactured of corrosion-resistant high-strength low-alloy Cor-Ten steel or equal. Number and length of bolts shall be as follows:

<u>Pipe Size</u>	<u>Number of Bolts</u>	<u>Bolt Diameter & Length (Inches)</u>
6"	6	3/4 x 3 1/2
8"	6	3/4 x 4
10"	8	3/4 x 4
12"	8	3/4 x 4
14"	10	3/4 x 4
16"	12	3/4 x 4 1/2
18"	12	3/4 x 4 1/2

- C. Coatings and Linings - Cast iron fittings shall be cement mortar lined per AWWA C-104 and receive a bituminous coating per AWWA C110.

Threaded holes and mating surfaces shall not be coated. Flange faces shall be coated with asphaltic varnish only. There shall be no coating materials or mortar in gasket grooves.

- D. Mechanical Couplings - Couplings include transition couplings, flanged coupling adapters, flexible and insulated couplings.

1. Coupling Sleeves and Flanges - Coupling sleeves and flanges may be of gray iron or carbon steel.

2. Bolts and Nuts for Flanges - Bolts and nuts for buried and submerged flanges, flanges in underground vaults and structures, and flanges located outdoors above ground shall be cadmium plated, A307, Grade B. Provide one washer for each nut. Each washer shall be of the same material as the nut.

3.0 EXECUTION

- 3.1 Handling and Transportation - Handling and transportation of pipe shall be in accordance with the pipe manufacturer's published instructions.

Heavy canvas, or nylon slings of suitable strength shall be used for lifting and supporting materials. Chains or cables shall not be used.

Pipe and fittings shall not be stored on rocks or gravel, or other hard material which might damage the pipe.

- A. Rubber Gasket Storage - All rubber gaskets shall be stored in a cool, well ventilated place and should not be exposed to the direct rays of the sun. Gaskets shall not be allowed in contact with oils, fuels, petroleum, or solvents.

- 3.2 Pipe Laying - Pipe shall be laid in accordance with the pipe manufacturer's published instructions, as complimented and modified herein and in the plans.

- A. Cleanliness - The interior of pipes shall be clean of foreign materials before sections of pipe are installed and shall be protected to prevent entry of foreign materials after installation.

Open ends of installed pipe shall be sealed with watertight plugs or other approved means at times when pipe installation is not in progress.

Ground water shall not be allowed to enter the pipe.

- B. Inspection Before Installation - All pipe and fittings shall be carefully examined for cracks and other defects just prior to installation. Spigot ends shall be examined with particular care as this area is the most vulnerable to damage from handling. Defective pipe or fittings shall be laid aside for inspection by the District, who will prescribe corrective repairs or rejection.

- C. Lowering of Pipe Material into Trench - Proper implements, tools, and equipment, satisfactory to the District, shall be provided and used by the contractor, for the safe and convenient performance of the work. All pipe, fittings, valves, and hydrants shall be carefully lowered into the trench piece by piece in such a manner as to prevent damage to the water main materials and protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench.

If damage occurs to any pipe, fittings, valves, hydrants or water main accessories in handling, the damage shall be immediately brought to the District's attention.

- D. Laying of Pipe - Pipe shall be laid in trenches to the line and grade indicated on the plans and as specified.

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. If the pipe laying crew cannot install the pipe into the trench without getting earth into it, the District Inspector may require a heavy tightly woven canvas bag of suitable size, or plastic caps to be placed over each end of the pipe prior to installation and left there until the connection is made to the adjacent pipe. During laying operations, no debris, tools, clothing or other material shall be placed in the pipe.

As each length of pipe is placed in the trench, the spigot end shall be centered in the bell or coupling, and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material tamped under it, except at the bells or couplings. Precautions shall be taken to prevent dirt from entering the joint space.

Joints shall be assembled in, accordance with the manufacturer's instructions. Rubber rings and ring grooves shall not be lubricated. Each joint shall be checked with a feeler gauge to assure proper seating of the gasket.

- E. Cutting of Pipe - Field cuts and connections shall be in accordance with the pipe manufacturer's published instructions.

The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe. The pipe shall be marked around its entire circumference prior to cutting to assure a square cut. A factory-finished beveled end shall be used as a guide for proper bevel angle (15°) and depth of bevel plus the distance to the insertion reference mark. The end shall be beveled using a PVC pipe beveling tool. Round off any sharp edges on the leading edge of the bevel with a pocket knife or a file.

When installing 8-, 10- and 12-inch PVC pipe, mechanical joint or push-on type fittings designed for ductile iron pipe shall be used. When connecting PVC pipe into the bell end of cast iron pipe or into push-on type fittings, the end should be rebeveled, similar to the bevel on ductile iron pipe. When connecting to mechanical joint fittings, the end of the PVC pipe should not be beveled.

- F. Allowable Deflection - No deflection shall be allowed at the joints.

The maximum allowable angular deflection at twin-gasketed couplings shall be 5 degrees.

The pipe shall not be bent to a lesser radius than the minimum shown below:

<u>Size (Inches)</u>	<u>Minimum Radius of Curvature (Feet)</u>
4	190
6	200
8	250
10	Fittings Required
12	Fittings Required

- G. Locating Wire - Locating wire shall be installed with non-metallic water pipe as indicated on the Standard Drawings.

H. Warning Tape - Warning tape shall be placed on top of pipe zone backfill centered over pipe as shown on the Standard Drawings.

3.3 Fittings - Fittings shall be installed in the manner specified herein for cleaning, laying and joining pipe.

A. Anchorage for Fittings - All fittings, unless otherwise specified, shall be provided with a thrust block constructed against undisturbed soil as shown on the Standard Drawings.

B. Thrust Blocks - Thrust blocks shall be constructed of Class B Concrete. Care shall be taken not to obstruct the outlets of tees or crosses which are intended for future connections. A waterproof paper or plastic bond-breaker shall be placed between plugs and caps and the concrete thrust block to facilitate their removal of the concrete in the future. Thrust blocks shall be poured against undisturbed earth and shall have at least the minimum dimensions shown on the Standard Drawings.

C. Mechanical Couplings - Oil, scale, rust, and dirt shall be cleaned from pipe ends. The contractor shall clean gaskets in couplings prior to installing the coupling in accordance with the manufacturer's recommendations.

Bolt threads shall be lubricated with graphite and oil prior to installation.

1. Painting and Coating -

a. The contractor shall coat buried flexible pipe couplings, transition couplings, and flanged coupling adapters per Section 09 90 00 and then wrap the couplings with polyethylene wrap per AWWA C-105.

b. The contractor shall coat flexible pipe couplings (including joint harness assemblies), transition couplings, and flanged coupling adapters located indoors, in vaults and structures, and above ground with the same coating system as specified for the adjacent pipe. A prime coat shall be applied at the factory.

D. Polyethylene Wrap - All ferrous metal shall be protected with polyethylene wrap. When it is not practical to wrap tees, crosses, and other odd-shaped pieces in a tube the item shall be wrapped with a flat sheet or split length of polyethylene tube by passing the

sheet under the appurtenance and bringing it up around the body. Seams shall be made by bringing the edges together, folding over twice, and taping down. Polyethylene shall be taped securely in place.

Cuts, tears, punctures, or damage to polyethylene shall be repaired with adhesive tape, or with polyethylene sheet secured in place with adhesive tape.

- 3.4 Testing and Disinfection - Testing and disinfection shall be performed on all pipelines in accordance with Section 33 13 00.

END OF SECTION

DOMESTIC SERVICE LINES AND APPURTENANCES

1.0 GENERAL

1.1 Scope - This section governs materials and installation of the following:

- A. Service line materials and fittings
- B. Meter Boxes

1.2 Submittals - The following items shall be submitted and approved by the District.

- A. Manufacturer's catalog data showing model, part number, pressure ratings and materials of construction.

2.0 MATERIALS

2.1 Service Line Materials and Fittings - Service line materials and fittings include service line pipe, service saddles, service fittings, meter stops, corporation stops, curb stops, and ball valves.

A. Polyethylene Tubing (PE) - PE tubing shall be in accordance with AWWA C901 and correspond to copper tubing size (CTS). The tubing shall be marked with the following:

- Nominal size
- Material code; i.e., PE 3406
- The word "Tubing" and dimension ratio
- AWWA pressure class; i.e., PC 160
- AWWA designation AWWA C901
- Manufacturer's name or trademark
- Seal of testing agency

The polyethylene material shall be type "3408" conforming to ASTM D3350. The pressure class shall be a minimum of 200 psi.

Stainless steel liners or inserts shall be used with PE tubing when compression type connections are specified or shown

B. Service Saddles - Service saddles shall be constructed of bronze, have AWWA iron pipe thread outlet taps, comply with AWWA C-800 "Threads for Underground Service Line Fittings" and have suitable means for attachment and sealing to a water main. The

body shall be made to conform to outside configuration of the main. The service saddle shall be designed to provide a drip-tight connection when used as a service connection to the main. Saddles for ductile iron pipe shall be double strap. Straps for PVC pipe may also be stainless and shall provide full support around the circumference of the pipe and have a bearing area of sufficient width so that the pipe will not be distorted when the saddle is tightened.

- C. Corporation Stops - Corporation stops shall be constructed of bronze, have AWWA iron pipe inlet threads, and shall comply with the requirements of AWWA C-800, "Threads for Underground Service Line Fittings." Outlets for ¾-inch and 1-inch corporation stops shall have "stab type" connectors for joining to CTS polyethylene tubing. Male iron pipe threads shall be provided on the outlet side of 1 ½-inch and 2-inch corporation stops.
- D. Fittings - Fittings including PE tubing couplings, bends, unions, and adapters shall be constructed of bronze and shall be designed to join to CTS polyethylene tubing using a "stab type" connection (Mueller or approved equal) in ¾-inch and 1-inch sizes and compression type connections in 1½-inch and 2-inch sizes. Fittings shall also have male or female iron pipe-size-threaded ends and/or meter coupling nut or meter flange as required.
- E. Angle Meter Stops - Angle meter stops shall be constructed of bronze, have lock wings and be suitable for joining to CTS polyethylene using a "stab type" connection for 1½-inch and 1-inch angle meter stops and a compression type connection for 1 ½-inch and 2-inch angle meter stops. Outlets for ¾-inch and 1-inch angle meter stops shall consist of a meter coupling nut. 1½-inch and 2-inch angle meter stops shall have meter flange outlets.

2.2 Meter Boxes - The meter boxes for ¾-inch, 1-inch, 1½-inch and 2-inch meters shall be concrete with steel lids in traffic areas. Plastic boxes and lids shall be used in non-traffic areas, according to the following:

<u>Meter Size</u>	<u>Box Inside Dimensions (Min.)</u>
¾ inch, 1 inch	10 x 17 inches
1½ inch, 2 inch	13 x 24 inches

3.0 EXECUTION

3.1 Polyethylene Tubing - Tubing and fittings should be stored in a way that prevents damage due to crushing or piercing, excessive heat, harmful

chemicals, or exposure to sunlight for prolonged periods. The manufacturer's recommendations regarding storage should be followed.

Handling operations and trench installation and backfill shall be performed with reasonable care to prevent scratches, nicks, and gouges in the conduit.

Pipe excessively cut or kinked shall not be used.

Bends in PE tubing shall not occur closer than 10 diameters from any fitting or valve. The minimum radius of curvature is 30 diameters or the coil radius when bending with the coil. Bending of coiled tubing against the coil shall not go beyond straight. Polyethylene tubing that becomes kinked during handling or installation shall not be used, and care should be taken to ensure that kinking does not develop after installation. Service line from the main line tap to the angle meter stop shall be one continuous length of tubing.

PE tubing shall be installed in trench bottoms with six-inches of bedding material to provide continuous and uniform support. The initial backfill shall be six inches above the tubing and shall be materials free from rock, stones, and debris.

- 3.2 Service Saddles - The service saddle shall be no closer than 18 inches to a valve, coupling, joint, or fitting, unless it is at the end of the main.

The surface of the pipe shall be free of all loose material and have a hard, clean surface before placing the service saddle.

The service saddle shall be tightened firmly to ensure a tight seal, however, care shall be used to prevent damage or distortion of either the pipe, corporation stop or service saddle by overtightening.

The drilling of the pipe shall be performed in accordance with the pipe manufacturer's recommendation.

- 3.3 Fittings, Angle Meter Stops, and Boxes - Installation of fittings, meter stops, and boxes shall be as recommended by the manufacturer. Pipe or fittings made of nonferrous metals (bronze) shall be isolated from ferrous metals with insulating unions or couplings.

- 3.4 Hydrostatic Testing - The Contractor shall hydrostatic test all appurtenances in place with the pipe being tested.

END OF SECTION

TESTING AND DISINFECTING WATER MAINS

1.0 GENERAL

- 1.1 Scope - All completed waterlines, as well as the service assemblies and appurtenant structures, will be tested by the contractor in the inspector's presence prior to field acceptance of the work. The contractor shall correct all defects in workmanship or materials which become evident by inspection or testing at any time during the work.

Testing shall be done after the complete installation and compaction of all underground utilities, except as modified below.

The contractor shall furnish all pipe and fittings for connection to the main, pumps, pressure regulator, a calibrated water storage tank, disinfectant, and all other materials, fittings and pipelines required to perform the tests and make the necessary repairs.

When lines to be tested are in areas that will be paved, testing shall be done after the rock subgrade is placed and compacted. No lines shall be accepted as passing until all underground construction that may disturb the waterline is compacted.

The pressure test and the test for allowable leakage shall be performed simultaneously. Testing shall not commence until the water main and all appurtenances have been completely installed. The contractor may, at any time and at his expense, perform his own pressure and leak test; however these tests will in no way offset the requirement for a final pressure and leak test.

After successfully testing the water main and appurtenances, they shall be flushed and disinfected.

After having been successfully tested and disinfected, the water main may be connected to the District's water system.

- 1.2 Submittals - The contractor shall notify the District a minimum of three business days in advance of its proposed testing schedule for review and concurrence. If requested, the contractor's proposed plans for water conveyance, disinfection, control, and disposal, shall also be submitted in writing.

2.0 MATERIALS

- 2.1 General - All test equipment, chemicals for chlorination, temporary valves, bulkheads, or other water control equipment and materials shall be determined and furnished by the contractor, subject to the District's review. No materials shall be used which would be injurious to the construction or its future function.
- 2.2 Hydrostatic Testing Equipment - The contractor shall be responsible for supplying and operating all testing equipment. In general, the testing equipment configuration shall consist of a pump receiving water from a calibrated storage tank. The pump discharge shall enter the water main through a tap or appurtenance. A pressure sustaining valve shall be placed on a tee located in the pump discharge line. Discharge from the pressure sustaining valve shall return to the calibrated storage tank. Other types or configurations of testing equipment shall be subject to District approval. The pressure pump shall operate continuous throughout the testing period. If the pump is stopped, the pressure shall not be allowed to drop more than two psi below test pressure before starting the pump.
- 2.3 Chlorine - Chlorine for disinfection shall be in the form of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or 5-g tablets.
- A. Liquid chlorine shall be in accordance with requirements of AWWA-B 301. Liquid chlorine shall be used only:
1. In combination with appropriate gas flow chlorinators and ejectors
 2. Under the direct supervision of an experienced technician
 3. When appropriate safety practices are observed
- B. Sodium hypochlorite and calcium hypochlorite shall be in accordance with the requirements of AWWA-B 300, and containing approximately 65% available chlorine by weight.

3.0 EXECUTION

- 3.1 General - The contractor shall make all necessary provisions for conveying the water from the District designated source to the points of use.

All pressure pipelines shall be tested. Disinfection shall be accomplished by chlorination. All chlorinating and testing operations shall be performed in the presence of the District.

Disinfection operations shall be scheduled by the contractor as late as possible during the contract time period so as to assure the maximum degree of sterility of the facilities before the Work is accepted by the District. Bacteriological testing shall be performed by the District.

Release of water from pipelines, after testing and disinfecting have been completed, shall be in accordance with a written disposal plan reviewed by the Engineer.

3.2 Hydrostatic Testing - The purpose of the hydrostatic test is both to test the ability of the pipeline to withstand pressure and test for allowable leakage. These tests shall run simultaneously.

A. Preparation - Prior to testing, the water main shall be slowly and carefully filled with water. All air shall be expelled slowly from the pipe and appurtenances in a manner so as not to create excessive surge pressures. All appurtenances shall be left on during the testing procedure. The line shall be filled with water at least 24 hours prior to testing when the pipeline has a mortar lining, thus allowing the lining material to become saturated. Water for testing shall be introduced at the low end of the section being tested to facilitate the elimination of air in the pipeline prior to testing. Where air valves or other suitable outlets are not available for releasing air before applying the test, approved taps and fittings shall be installed and later securely plugged.

The contractor may, at his own risk, test against existing valves. Suspected leaking of these valves will not be accepted as a reason for having not passed the leakage test requirements. These valves shall either be repaired or replaced prior to the start of another testing sequence. All new valves shall be tested against a reduced pressure side. Butterfly valves shall be tested in both directions.

B. Test Section Length - The length of pipe being tested at any one time shall not exceed 2,000 feet unless otherwise approved by the District.

C. Test Pressure - The test pressure shall be 200 psi or 50 psi greater than design pressure of the system, whichever is greater, measured at the lowest point of the section of the pressure zone being tested.

- D. Test Duration - The test duration shall be two hours. Pressure in the water main shall be maintained within two psi of the calculated test pressure for the full two-hour duration. The individual testing of the valves may be of a shorter duration as approved by the District.
- E. Allowable Leakage - The allowable leakage per test section shall be calculated from the formula contained in this subsection. Different sized water mains and different water main materials that might be contained within the same test section shall be calculated separately and then added together.

$$W = ND \frac{\sqrt{P}}{7400} \text{ WHERE:}$$

W = Allowable leakage in gal/hr.

N = Number of joints in the length of pipeline tested

D = Normal diameter in inches

P = Average test pressure in psi

- F. Repairs - During the pressure and leakage test, all accessible appurtenances shall be inspected for visual signs of leakage. All visual leaks shall be corrected immediately, regardless of the amount of leakage and the test shall be run again for its full duration. All leaks detected shall be repaired to a water tight condition. All repairs made shall be retested in accordance with the specifications. All repairs shall be made and a successful test accomplished prior to taking bacteriological samples.

- 3.3 Disinfecting - After completion of testing operations, the contractor shall sterilize all water mains, services and appurtenances. Sterilization shall be accomplished in accordance with the latest revision of AWWA C-601.

The basic disinfection procedure consists of:

- Preventing contamination materials from entering the water main during storage, construction, or repair.
- Removing, by flushing or other means, those materials that may have entered the water main.
- Chlorinating any residual contamination that may remain, and flushing the chlorinated water from the main.
- Determining the bacteriological quality by laboratory test after disinfection. Three methods of chlorination are: tablet, continuous feed, and slug. The tablet method is preferred and shall be used

unless an alternate method is approved by the Engineering Department.

- A. Tablet Method - The tablet method consists of placing calcium hypochlorite granules and tablets in the water mains as it is being installed and filling the main with potable water when installation is completed.

This method may be used only if the pipes and appurtenances are kept clean and dry during construction.

- B. Placing of Calcium Hypochlorite Granules - During construction, calcium hypochlorite granules shall be placed at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500 foot intervals. The quantity of granules shall be as shown in Table 1.

WARNING: This procedure must not be used on solvent-welded plastic or on screwed-joint pipe because of the danger of fire or explosion from the reaction of the joint compounds with the calcium hypochlorite.

TABLE 1	
OUNCES OF CALCIUM HYPOCHLORITE GRANULES TO BE PLACED AT BEGINNING OF MAIN AND AT EACH 500-FOOT INTERVALS	
Pipe Diameter Inches	Calcium Hypochlorite Granules oz.
4	0.5
6	1.0
8	2.0
12	4.0
16 and Larger	8.0

- C. Placing of Calcium Hypochlorite Tablets - During construction 5-g calcium hypochlorite tablets shall be placed in each section of the pipe and also one such tablet shall be placed in each hydrant, hydrant branch, and other appurtenances. The number of 5-g tablets required for each pipe section shall be $.0012d^2L$ rounded to the next higher integer, where "d" is the pipe diameter in inches and "L" is the length of pipe section in feet. Table 2 shows the number of tablets required for commonly used sizes of pipe.

TABLE 2 NUMBER OF 5-G CALCIUM HYPOCHLORITE TABLETS REQUIRED FOR DOSE OF 25 MG/L* Length of Pipe Section Ft.					
Pipe Diameter in.	13 or less	18	20	30	40
<u>Number of 5-g Calcium Hypochlorite Tablets</u>					
4	1	1	1	1	1
6	1	1	1	2	2
8	1	2	2	3	4
10	2	3	3	4	5
12	3	4	4	6	7
16	4	6	7	10	13
18	5	7	8	12	16

*Based on 3.25g available chlorine per tablet; any portion of tablet rounded to next higher number.

The tablets shall be attached by a food-grade adhesive such as Permatex Form-A-Gasket No. 2 or equal. There shall be no adhesive on the tablet except on the broad side attached to the surface of the pipe. Attach all the tablets inside and at the top of the main, with approximately equal numbers of tablets at each end of a given pipe length. If the tablets are attached before the pipe section is placed in the trench, their position shall be marked on the section so it can be readily determined that the pipe is installed with the tablets at the top.

- D. Filling and Contact - When tablet installation has been completed, the main shall be filled with water at a rate such that the water within the main will flow at a velocity no. greater than 1 ft/s. Precautions shall be taken to assure that air pockets are eliminated. This water shall remain in the pipe for at least 24 hours. If the water temperature is less than 41° F (5° C), the water shall remain in the pipe for at least forty-eight hours. Valves shall be positioned so that the strong chlorine solution in the treated main will not flow into water mains in active service.
- E. Final Flushing - After the applicable retention period, heavily chlorinated water should not remain in prolonged contact with pipe. In order to prevent damage to the pipe lining or corrosion damage to the pipe itself, the heavily chlorinated water shall be flushed from the main until chlorine measurements show that the concentration in the water leaving the main is no higher than that which is generally prevailing in the system or is acceptable for domestic use.

The environment to which the chlorinated water is to be discharged shall be inspected. If there is any question that the chlorinated discharge will cause damage to the environment, then a reducing agent shall be applied to the water to be wasted to neutralize thoroughly the chlorine residual remaining in the water. Where necessary, federal, state, and local regulatory agencies should be contacted to determine special provisions for the disposal of heavily chlorinated water.

- F. Bacteriological Tests - After completion of testing and sterilization, prior to final acceptance, the District will take water samples for bacteriological examination. Should any of the samples fail to meet minimum State of California, Department of Public Health requirements, the contractor will continue to chlorinate and flush the system, as directed, until a satisfactory sample is obtained.
- G. Redisinfection - If the initial disinfection fails to produce satisfactory bacteriological samples, the main may be re-flushed and shall be resampled. If check samples show the presence of coliform organisms, then the main shall be re-chlorinated by the continuous-feed or slug method of chlorination until satisfactory results are obtained.

NOTE: High velocities in the existing system, resulting from flushing the new main, may disturb sediment that has accumulated in the existing mains. When check samples are taken, it is well to also sample water entering the new main.

END OF SECTION

DUCTILE IRON PIPE AND FITTINGS
(GRAVITY SEWER FLOW)

1.0 GENERAL

- 1.1 Scope - This specification governs the furnishing and installation of ductile iron pipe material, including laying, joining, bedding and approvals. All incidentals and appurtenant operations necessary for the construction of pipelines shall be accomplished in strict accordance with the drawings and other terms and conditions of the contract.

The contractor shall also furnish all equipment, tools, labor and materials required to relocate sewers, conduits, ducts, pipes, or other structures as may be necessary to complete the installation as shown and specified.

All standard specifications, i.e., AWWA, ASTM, etc., made a portion of these specifications by reference shall be the latest edition and revision thereof.

The contractor shall be responsible for all material furnished by him, and shall replace at his own expense, all material found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include the furnishings of all material and labor required to replace defective material discovered prior to final acceptance of the work.

The contractor shall be responsible for the safe storage of material until it has been incorporated into the completed project. The interior of all pipe shall be kept free from dirt and foreign matter at all times.

Pipe surfaces shall be free from nicks, scratches and other blemishes. The joining surfaces of pipe spigots and bell sockets shall be free from gouges or other imperfections that might cause leakage.

- 1.2 Submittals - Submittals shall be provided for the following items plus all additional items required in the specifications for the particular type of pipe:

- Pipe and joint material

2.0 MATERIALS

- 2.1 Ductile Iron Pipe (DI) - Ductile iron pipe shall conform to the quality and strength requirements of AWWA C-151.

- A. Markings - Each standard or random length of pipe shall be clearly marked with the following:
- The letters "DI" or "Ductile"
 - Nominal size and class
 - Year produced
 - Manufacturer's trade name and country where cast
 - Seal (mark) of testing agency
- B. Pressure Class - Where the class is not indicated on the plans, the pipe shall be Class 350.
- C. Laying Length - Standard laying lengths of 18 or 20 feet are acceptable.
- D. Joint Type - Unless otherwise shown or specified, pipe joints shall be rubber gasket push-on type joint conforming to AWWA C-111.
- E. Physical Test Requirements - Hydrostatic, tension test, and impact test shall be conducted at the factory in accordance with ASTM A746. All testing shall be performed by a recognized testing laboratory with such testing available for inspection by the District. If required, the manufacturer shall supply a letter of certification attesting to their pipe meeting these specifications.
- F. Lining and Coating - Lining and Coating shall be as specified on the plans or Special Conditions.
- G. Polyethylene Encasement - Pipe and fittings shall be wrapped in polyethylene. Polyethylene wrapping shall be in accordance to with AWWA C-105 latest revision. Minimum thickness shall be 0.008 inch (8 mils).
- H. Warning Tape - Two-inch-wide green non-metallic tape marked "sewerline" shall be used.

3.0 EXECUTION

- 3.1 Handling and Transportation - Handling and transportation of pipe shall be in accordance with the pipe manufacturer's published instructions.

Heavy canvas or nylon slings of suitable strength shall be used for lifting and supporting materials. Chains or cables shall not be used.

Pipe and fittings shall not be stored on rocks or gravel, or other hard material which might damage the pipe.

- A. Rubber Gasket Storage - All rubber gaskets shall be stored in a cool, well ventilated place and not exposed to the direct rays of the sun. Gaskets shall not be allowed in contact with oils, fuels, petroleum, or solvents.

3.2 Pipe Laying - Pipe shall be laid in accordance with the pipe manufacturer's published instructions, as complimented and modified herein.

- A. Cleanliness - The interior of pipes shall be clean of foreign materials before sections of pipe are installed and shall be protected to prevent entry of foreign materials after installation.

Open ends of installed pipe shall be sealed with watertight plugs or other approved means at times when pipe installation is not in progress.

Ground water shall not be allowed to enter the pipe.

- B. Inspection Before Installation - All pipe and fittings shall be carefully examined for cracks and other defects while suspended and before installation. Spigot ends shall be examined with particular care as this area is the most vulnerable to damage from handling. Defective pipe or fittings shall be laid aside for inspection by the District, who will prescribe corrective repairs or rejection.

- C. Lowering of Pipe Material into Trench - Proper implements, tools, and equipment, satisfactory to the District, shall be provided and used by the contractor for the safe and convenient performance of the work. Under no circumstances shall sewer main materials be dropped or dumped into the trench.

If damage occurs to any pipe or accessories in handling, the damage shall be immediately brought to the District's attention.

- D. Laying of Pipe - Pipe shall be laid in trenches to the line and grade indicated on the plans and as specified.

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. If the pipe laying crew cannot install the pipe into the trench without getting earth into it, the District's Inspector may require a heavy tightly woven canvas bag of suitable size, or plastic caps, be placed over each end of the pipe prior to installation and left there until the connection is made to the adjacent pipe. During laying operations, no debris, tools, clothing or other material shall be placed in the pipe.

As each length of pipe is placed in the trench, the spigot end shall be centered in the bell or coupling, and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material tamped under it, except at the bells or couplings. Precautions shall be taken to prevent dirt from entering the joint space.

Joints shall be assembled in accordance with the manufacturer's instructions. Each joint shall be checked with a feeler gauge to assure proper seating of the gasket.

- E. Cutting of Pipe - Field cuts and connections shall be in accordance with the pipe manufacturer's published instructions.

The cutting of pipe for inserting valves, fittings, or closure pieces, shall be done in a neat and workmanlike manner without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe.

- F. Allowable Deflection - The maximum allowable angular deflection at the joints shall be 80% of manufacturer's recommendation for push-on and mechanical joints. Changes in direction greater than the allowable deflection shall be accomplished with manholes.

- 3.3 Polyethylene Encasement - The polyethylene encasement shall prevent contact between the pipe and the surrounding backfill and bedding materials, but is not intended to be a completely airtight or watertight enclosure. All lumps of clay, mud, cinders, etc., on the pipe surface shall be removed prior to installation of the polyethylene encasement. During installation, care shall be exercised to prevent soil or embedment material from becoming trapped between the pipe and the polyethylene.

The polyethylene film shall be fitted to the contour of the pipe to effect a snug, but not tight, encasement with a minimum space between the polyethylene and the pipe. Sufficient slack shall be provided in contouring to prevent stretching the polyethylene where it bridges irregular surfaces, such as bell-spigot interfaces, bolted joints, or fittings, and to prevent damage to the polyethylene due to backfilling operations. Overlaps and ends shall be secured with adhesive tape.

For installations below the water table, both ends of the polyethylene tube shall be sealed as thoroughly as possible with adhesive tape at the joint overlap.

Installation of polyethylene encasement shall be in accordance with the Standard Drawings and AWWA C-105, Method A. The following summarizes this method.

- A. Installation of Polyethylene Encasement for Pipe - Cut polyethylene tube to a length approximately two feet longer than the pipe section. Slip the tube around the pipe, centering it to provide a one-foot overlap on each adjacent pipe section, and bunching it accordion-fashion lengthwise until it clears the pipe ends.

Lower the pipe into the trench and make up the pipe joint with the preceding section of pipe. A shallow bell hole must be made at the joints to facilitate installation of the polyethylene tube.

After assembling the pipe joint, make the overlap of the polyethylene tube. Pull the bunched polyethylene from the preceding length of pipe, slip it over the end of the new length of pipe, and secure it in place. Then slip the end of the polyethylene from the new pipe section over the end of the first wrap until it overlaps the joint at the end of the preceding length of pipe. Secure the overlap in place. Take up the slack width at the top of the pipe to make a snug, but not tight, fit along the barrel of the pipe, securing the fold at quarter points.

Any cuts, tears, punctures, or other damage to the polyethylene, shall be repaired as described below. Proceed with installation of the next section of pipe in the same manner.

- B. Installation of Polyethylene Encasement for Appurtenances - Cover bends, reducers, offsets, and other pipe-shaped appurtenances with polyethylene in the same manner as the pipe. When it is not practical to wrap tees, crosses, and other odd-shaped pieces in a tube, the items shall be wrapped with a flat sheet or split length of polyethylene tube by passing the sheet under the appurtenance and bringing it up around the body. Seams shall be made by bringing the edges together, folding over twice, and taping down. Polyethylene shall be taped securely in place.
- C. Repairs of Polyethylene Encasement - Repair any cuts, tears, punctures, or damage to polyethylene with adhesive tape, or with a short length of polyethylene sheet or a tube cut open, wrapped around the pipe to cover the damaged area, and secured in place.

- 3.4 Testing and Disinfection - Testing and disinfection shall be performed on all pipelines, in accordance with Section 33 01 30.13.

END OF SECTION

POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS
(GRAVITY SEWER FLOW)

1.0 GENERAL

- 1.1 Scope - This Section of the specifications will govern the furnishing and installation of PVC pipe material and fittings; including laying, jointing, bedding, testing and approvals. All incidentals and appurtenant operations necessary for the construction of pipelines shall be done in strict accordance with the drawings and other terms and conditions of the contract.

The contractor shall also furnish all equipment, tools, labor and materials required to rearrange sewers, conduits, ducts, pipes, or other structures as may be necessary to provide installation as shown and specified.

All standard specifications, i.e., ASTM, etc., made a portion of these specifications by reference shall be the latest edition and revision thereof.

The contractor shall be responsible for all material furnished by him and shall replace it at his own expense, should the material be defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include the furnishing of all material and labor required to replace defective material discovered prior to final acceptance of the work.

Pipe surfaces shall be free from nicks, scratches and other blemishes. The joining surfaces of pipe spigots and of integral bell and sleeve reinforced bell sockets shall be free from gouges or other imperfections that might cause leakage.

- 1.2 Storage and Care - The contractor shall be responsible for the safe storage of material furnished by or to him and accepted by him, and intended for the work, until it has been incorporated in the completed project. The interior of all pipe and fittings shall be kept free from dirt and foreign matter at all times.

Pipe shall be stored at the job site in unit packages provided by the manufacturer. Caution shall be exercised to avoid compression, damage or deformation to bell ends of the pipe. If pipe is to be exposed to direct sunlight for more than 14 days, pipe must be covered with an opaque material while permitting adequate air circulation above and around the pipe to prevent excessive heat accumulation.

Gaskets shall be protected from excessive exposure to heat, direct sunlight, ozone, oil and grease. Solvent cement when used shall be stored in tightly sealed containers away from excessive heat.

1.3 Submittals - Submittals shall be provided for the following items plus all additional items required in the specifications for the particular type of pipe:

1. Pipe and jointing material
2. Fittings
3. Specialties

2.0 MATERIALS

2.1 Polyvinyl Chloride Pipe (PVC) and Fittings - PVC pipe and fittings shall be made in accordance to ASTM D-3034 or ASTM F679, and ASTM D1784 in both physical, dimensional and chemical requirements. Pipe shall be green unless otherwise approved.

A. Markings - Each standard or random length of pipe shall be clearly marked with the following:

- Manufacturer's name
- Nominal pipe size, i.e. six-inch
- Cell classification or material code; i.e. 12454-B
- Dimension ratio; i.e. SDR35
- Product type; i.e. Type PSM
- Standard specification designation; i.e. 03034
- Production code

B. Pipe Class - The SDR or wall thickness shall be as shown on the plans.

C. Laying Length - The standard laying length shall be 20 feet (plus/minus) 1 inch. A maximum of 15% may be furnished in random lengths of not less than 10 feet each.

D. Joint Type - Pipe joints shall be constructed with an integral bell and spigot with an elastomeric gasket push-on-type joint. Each spigot shall have a reference mark to facilitate pipe assembly. The gasket shall be contained in a machined groove on the pipe spigot such that when compressed the gasket will not displace and will form a positive seal. The gasket shall meet all requirements of ASTM F-477; pipe lubricant shall be listed with NSF (National Sanitation Foundation).

Solvent cement joints are strictly prohibited.

E. Physical Test Requirements -

1. Material - Material samples shall be taken at the beginning of production and tested for compliance to ASTM D-3034 or ASTM F794.
2. Product Quality - The following tests shall be performed on a sample of pipe.

Flattening - Three specimens of pipe per pipe size furnished, minimum of six inches long, shall be flattened between parallel plates in a suitable press until the distance between the plates is 40% of the outside diameter of the pipe. The rate of loading shall be uniform and such that the compression is completed within two to five minutes. Remove the load, and examine the specimens for splitting, cracking, or breaking.

Pipe Stiffness - The pipe stiffness shall be determined utilizing procedures similar to those outlined in ASTM D2412. The stiffness of pipe shall be determined at a 5% deflection datum. Test specimens shall be a minimum of two pipe diameters or four feet in length, whichever is less.

Joint Tightness - Joint tightness shall be tested in accordance with ASTM D3212.

The manufacturer shall provide a certificate of conformance for the above tests. Tests shall be performed on materials and products from the same lot of those furnished to the project.

Plant Inspection - The District may require inspection of production of the pipe. When requested, the manufacturer shall provide advance notice of when and where production of materials will begin.

- F. Struts - All pipe, 24 inches in diameter and greater, shall be strutted prior to placement in the trench. Each strut shall consist of two 2x4's placed in a perpendicular cross. A minimum of four struts equally spaced shall be placed per pipe length. Struts are to be removed prior to backfill above the pipe zone.

- 2.2 Warning Tape - Warning tape shall be two-inch wide green non-metallic tape marked "sewerline."
- 2.3 Fittings - All fittings shall be as manufactured and furnished by the pipe supplier or approved equal and have bell and/or spigot configurations compatible with the pipe.

3.0 EXECUTION

- 3.1 Handling and Transportation - Handling and transportation of pipe shall be in accordance with the pipe manufacturer's published instructions.

Heavy canvas or nylon slings of suitable strength shall be used for lifting and supporting materials. Chains or cables shall not be used.

Pipe and fittings shall not be stored on rocks or gravel, or other hard material which might damage the pipe.

- A. Rubber Gasket Storage - Store all rubber gaskets in a cool, well ventilated place and do not expose to the direct rays of the sun. Do not allow contact with oils, fuels, petroleum, or solvents.

3.2 Pipe Laying -

- A. General - Pipe shall be laid in accordance with the pipe manufacturer's published instructions, as complimented and modified herein.
- B. Cleanliness - The interior of pipes shall be clean of foreign materials before sections of pipe are installed and shall be protected to prevent entry of foreign materials after installation.

Open ends of installed pipe shall be sealed with watertight plugs or other approved means at times when pipe installation is not in progress.

Groundwater shall not be allowed to enter the pipe.

- C. Inspection Before Installation - All pipe and fittings shall be carefully examined for cracks and other defects while suspended and before installation. Spigot ends shall be examined with particular care as this area is the most vulnerable to damage from handling. Defective pipe or fittings shall be laid aside for inspection by the District, who will prescribe corrective repairs or rejection.

- D. Lowering of Pipe Material into Trench - Proper implements, tools, and equipment, satisfactory to the District, shall be provided and used by the contractor, for the safe and convenient performance of the work. All pipe shall be carefully lowered into the trench piece by piece in such a manner as to prevent damage to the materials. Under no circumstances shall the pipe be dropped or dumped into the trench.

If damage occurs to any pipe or accessories in handling, the damage shall be immediately brought to the District's attention.

- E. Laying of Pipe - Pipe laying shall proceed upgrade with spigot ends pointing in the direction of flow. After a section of pipe has been lowered into the prepared trench, the contractor shall clean the end of the pipe to be joined, the inside of the joint, and the rubber ring immediately before joining the pipe. The assembly of the joint shall be made in accordance with the recommendations of the manufacturer of the type of joint used. The bell and spigot joint shall be pushed "home" in line with the installation band. If a piece has been cut, the usable end shall be clearly marked to show the proper amount of installation distance. All special tools and appliances required for jointing assembly shall be provided by the contractor.

After the joint has been made, the contractor shall check pipe for alignment and grade. The trench bottom shall form a continuous and uniform bearing and support along the length of the pipe between joints. Sufficient pressure in making the joint shall be applied to assure proper pipe alignment and joint makeup. Sufficient pipe zone material shall be placed to secure the pipe and prevent movement before the next joint is installed.

When pipe is laid within a movable trench shield, all necessary precautions shall be taken to prevent pipe joints from pulling apart when moving the shield ahead.

Precautions shall be taken to prevent excavated or other foreign material from getting into the pipe during the laying operation. At all times, when laying operations are not in progress, or whenever the workers are absent from the job, the contractor shall close and block the open end of the last laid section of pipe to prevent entry of foreign material or creep of the gasketed joints.

Pipes which are stubbed off for manhole construction or for connection by others shall be plugged or closed off with temporary plugs as specified in the manhole specifications.

The contractor shall take all precautions necessary to prevent the "uplift" or floating of the line prior to the completion of the backfilling operation.

Where pipe is connected to manholes or concrete structures without using a flexible connector, connections shall be made so that the standard pipe joint is located not more than 2 feet from the outside edge of the structure unless otherwise shown.

- F. Cutting of Pipe - Field cuts and connections shall be in accordance with the pipe manufacturer's published instructions.

The cutting of pipe for fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe. The pipe shall be marked around its entire circumference prior to cutting to assure a square cut. A factory finished beveled end shall be used as a guide for proper bevel angle and depth of bevel plus the distance to the insertion reference mark. The end shall be beveled using manufacturer recommendations. Sharp edges on the leading edge of the bevel shall be rounded off with a pocket knife or a file.

END OF SECTION

MANHOLES

1.0 GENERAL

- 1.1 Scope - The work covered by this section shall consist of furnishing all materials, accessories, equipment, tools, transportation, service, labor and performing all operations to furnish and install concrete manholes in accordance with this section of the specifications and applicable drawings. Testing of manholes shall be done in accordance with Section 33 01 30.13.

Precast concrete bases, wall sections, and covers shall be manufactured in a facility especially designed for that purpose and shall conform to the shapes and dimensions indicated on the plans.

- 1.2 Submittals - Prior to installation, the following information is to be submitted:
- A. Manufacturer's catalog data on precast items. Show dimensions, reinforcing thickness of walls, and top slab shall be shown. Show materials of construction by ASTM reference and grade.
 - B. Concrete mix design and reinforcing for cast-in-place concrete item.
- 1.3 Design Loads - Design loads shall consist of dead load, live load, impact, and, in addition, loads due to water table and any other loads which may be imposed upon the manhole.

2.0 MATERIALS

- 2.1 Concrete - Portland cement concrete shall conform to Class A as specified in the Caltrans Standard Specifications Section 90, "Portland Cement Concrete."
- 2.2 Reinforcement - Reinforcement shall be deformed reinforcement in accordance with ASTM A615 or ASTM A497 for welded deformed wire fabric.
- 2.3 Base Rock - Base Rock shall be 3/4-inch aggregate base conforming to Caltrans Specifications for Class 2 aggregate base.
- 2.4 Precast Manhole Wall Sections - Precast manhole sections shall be of the size indicated on the Drawings. The contractor shall provide the District with a Certificate of Compliance from the manhole manufacturer that the

manholes and concrete mix conform in all respects to these specifications and requirements of ASTM C478. Minimum wall thickness shall be 4 inches. Cones shall have the same wall thickness and reinforcement as manhole section. The top and bottom of all sections shall be parallel.

Joints shall be tongue-and-groove type.

- 2.5 Precast Base Sections and Adaptor Ring - Unless otherwise approved, all concrete manhole bases shall be precast. Connections to the base shall be made with elastomeric boots or an approved cast-in adaptor.
- 2.6 Manhole Extensions - Concrete grade rings for extensions shall be a maximum of six-inches high and shall be approved by the District before installation.
- 2.7 Mortar - Standard premixed mortar conforming to ASTM C387 or proportion 1 part Portland cement with 2 parts clean, well graded sand which will pass a 1/8-inch screen. Admixtures may be used provided they do not exceed the following percentages by weight of cement: Hydrated lime, 10%; diatomaceous earth or other inert materials, 5%. Consistency of mortar shall be such that it will readily adhere to the applied surface. Mortar mixed for longer than 30 minutes shall not be used.
- 2.8 Preformed Plastic Gaskets - Preformed plastic gaskets shall be used for the manhole assembly and shall be Kent-Seal No. 2 manufactured by Hamilton Kent Manufacturing Company, Box 178, Kent, OH 44240; Ram-Nek, manufactured by K.T. Snyder Company, Inc., Central National Bank Bldg., Houston, TX 77002; or equal, meeting all requirements of Federal Specifications SS-S00210.
- 2.9 Manhole Frames and Covers - Covers shall have the word SEWER in raised two-inch letters. Castings shall be tough, close-grained gray iron, sound, smooth, clean, free from blisters, blowholes, shrinkage, cold shuts, and all defects, and shall conform to ASTM A48, Class 30B. All bearing surfaces shall be machined to ensure true flat surfaces. Covers shall be true and seat within the ring at all points. Frames shall be water tight and be of the grooved gasketed type. Manhole frames and covers shall be as shown on the approved Materials List.
- 2.10 Backfill Material - Backfill material shall conform to Section 31 23 16. When material from the excavation is unsuitable for use in backfill, it shall be disposed of and suitable material, which is capable of attaining the required relative compaction, shall be arranged for and furnished.

3.0 EXECUTION

- 3.1 Excavation - The contractor shall prepare an excavation large enough to accommodate the structure and permit grouting of openings and backfilling operations. Excavations shall be made in accordance to Section 31 23 16. No earth backfill will be permitted to correct overdepth excavation. Over excavation shall be corrected as described in Section 31 23 16-3.2.
- 3.2 Precast Bases - Precast bases shall be placed on six-inches of pipe bedding material compacted to 95% and graded level. The top of the base, when installed, shall be level in all directions.
- 3.3 Cast-in-Place Bases - Manhole base shall be poured in accordance to the standard drawing against undisturbed soil. All vertical surfaces shall be poured against approved forms. The base shall extend to the lines shown on the details.

The manhole stubs and sewer main shall be set before the concrete is placed and shall be rechecked for alignment and grade before the concrete has set. The various sized inlets and outlets to the manhole shall be located as indicated on the plans and as detailed in the detail drawings. Invert elevations of connecting sewers may vary.

The invert of the manhole base shall be hand worked so as to provide channels conforming in size and shape to the lower portions of the inlets and outlets. The manhole invert channels shall be smooth and accurately shaped. Channels may be formed directly in the concrete base.

All transitions shall be smooth and of the proper radius to give an uninterrupted transition of flow.

The concrete base shall be shaped with a wood float and shall receive a hard steel trowel finish before the concrete sets.

In the event additional mortar is required after initial set has taken place, the surface to receive the mortar shall be primed, and the mortar mixed with a concrete adhesive in the amounts and proportions recommended by the manufacturer and as directed by the District in order to secure as chip-proof a result as possible.

The bases shall set a minimum of 24 hours before manhole construction is continued. In certain critical situations, the time of setting may be reduced upon approval of the District.

- 3.4 Manhole Assembly - Manhole assembly shall be as shown on the standard drawings. Each precast concrete unit shall be set plumb using preformed plastic gaskets at all joints.

It is the intent of these specifications that manholes and appurtenances be watertight and free from infiltrations. Manholes shall be free of any seeping or surface moisture prior to the application of a protective lining or coating. Adequate watertightness of manholes and appurtenances shall be determined by the District upon completion of testing by the contractor. All stubs shall be plugged with stoppers or brick wall plugs as shown on the plans for various sizes of pipe.

In order to prevent accidental use of the new sewer before completion and acceptance, the inlet to existing tie-in manholes shall be sealed. Installation of these plugs shall be approved by the District. Plugs shall be removed at the time of final inspection or as directed by the District.

- 3.5 New Connections to Existing Manholes - New connections to existing manholes, where stubs have not been provided, shall be made by core drilling through the wall and rebuilding the manhole bench as shown on the standard drawings.

- 3.6 Backfill - Backfill around manholes shall be placed and compacted in accordance to Section 31 23 16.

END OF SECTION

RECYCLED WATER SYSTEMS

1.0 GENERAL

- 1.1 Scope - This section governs the materials and installation of pipelines and fittings for recycled water systems. All components of recycled water systems shall conform to the specifications of the potable water system except as specified in this section.

2.0 MATERIALS

- 2.1 PVC Pipe - PVC recycled water piping shall be purple-colored. The pipe shall be identified as recycled water pipe by continuous marking. The markings shall include the following: CAUTION RECYCLED WATER - DO NOT DRINK. Nominal pipe size. PVC-1120. Pressure rating in pounds per square inch at 73 degrees Fahrenheit. ASTM designations such as 1785, 2241, 2672, 3139. Printing shall be placed continuous on two sides of the pipe.
- 2.2 Ductile Iron Pipe - Ductile iron pipe shall conform to Section 33 11 13.13 and shall be encased with purple plastic sleeve.
- 2.3 Plastic Wrap or Sleeve - The plastic warning wrap or sleeve shall be prepared with black printing on a purple field having the words, "CAUTION: RECYCLED WATER DO NOT DRINK".
- 2.4 Quick-coupling Valves - Quick-coupling valves shall be constructed of brass with a purple rubber or vinyl cover, and shall have a $\frac{3}{4}$ - or 1-inch inlet.
- 2.5 Valve Boxes
1. All gate valves, manual control valves, electrical control valves, pressure reducing valves for on-site recycled water systems shall be installed below grade in a valve box.
 2. Valve boxes should be the standard round-type concrete box with a special triangular, heavy-duty cover. All valve covers on the off-site nonpotable waterlines should be of non-interchangeable shape with potable water covers and with the recognition inscribed "Recycled Water" cast on the top surface.

2.6 Tags

Tags shall be weatherproof plastic, 3" x 4", purple in color with the words "WARNING RECYCLED WATER DO NOT DRINK". Imprinting shall be permanent and black in color. Use tags as manufactured by T. Christy Enterprises or approved equal.

2.7 Service Pipe - Service pipe shall be PE tubing per Technical Specification 33 12 13 encased in purple plastic sleeve.

3.0 EXECUTION

3.1 General - All buried PVC pipe in the recycled water system shall be purple colored with stenciling identifying it as recycled water in accordance with the AWWA Guidelines for the Distribution of Non-potable Water. Ductile iron pipe shall be wrapped with purple plastic wrap.

Standard PVC pipe completely wrapped with purple plastic wrap, as specified below, may be accepted as an alternative to stenciled purple colored PVC pipe only on a project-by-project basis with prior written approval from the District Engineer. The color of the wrap must be in accordance with the AWWA Guidelines for the Distribution of Non-potable Water.

Plastic Wrap shall be installed completely around the pipe. Plastic wrap shall be installed continuous for the entire length of the pipe and shall be fastened to each pipe length by plastic banded around the pipe with fasteners no more than five feet apart. Taping attached to the sections of pipe before laying in the trench shall have flaps sufficient for continuous coverage.

The District may require tags, as approved by the District, to be installed on designated facilities such as on valves and blowoffs. The tags will notify that the system contains recycled water that is unsafe to drink.

All recycled water facilities are to be clearly identified differently from potable water by being tagged or painted purple.

END OF SECTION

GATE VALVES

1.0 GENERAL

- 1.1 Scope - This specification governs materials and installation of gate valves. Valves shall be furnished and installed by the contractor at the locations shown on the approved plans, or as required by the District.
- 1.2 Submittals - Prior to the purchase of gate valves to be used in the District's system, the following items shall be submitted and approved by the District:
- Manufacturer's catalog data and detail construction sheets showing the size to be used, valve dimensions, pressure rating, and materials of construction.
 - Manufacturer's catalog data and NSF certification seal on the lining to be used.

2.0 MATERIALS

- 2.1 Gate Valves three inches and Larger - Gate valves three inches and larger, shall be resilient-seated suitable for buried service and meet the requirements of AWWA C-509, manually operated. All such valves shall be of the non-rising stem type, with double o-ring seal and shall turn to the left in a counter-clockwise direction to open the valve.

All valves shall be suitable for frequent operation as well as service involving long periods of inactivity. Valves shall be capable of operating satisfactorily with flows in either direction and shall provide zero leakage past the seat.

- A. Valve Body - Body, bonnet, operating nut, and stuffing box shall be of iron with internal working parts of solid bronze. Exposed capscrews, bolts and nuts shall be stainless steel type 304.

The word "open" and an arrow indicating the direction to open shall be cast on each valve body or operator.

- B. Valve Operator - Valve operators shall be equipped with a two-inch AWWA square operating nut. They shall be sealed and gasketed and lubricated for underground service. The operator shall be capable of withstanding an input torque of 450 ft. lbs. at extreme operator position without damage.

- C. Coating and Lining - Interior surfaces, excluding seating areas, bronze, and stainless steel pieces, shall be epoxy lined to a dry film thickness of 12 mils.

Liquid epoxy linings shall be applied in two coats. Liquid epoxy coating materials shall be listed in the NSF Listing for Drinking Water Additives, Standard 61, as certified for use in contact with potable water. Powder epoxy coating materials shall contain 100% solids. Surface preparation shall include White Metal Blast Cleaning.

Exterior surfaces shall be shop coated with two coats of asphalt varnish conforming to AWWA C-509. Flange faces shall be coated with a rust preventive compound.

- D. Marking - The manufacturer shall show on the valve the size, manufacturer, class and year.
- E. Gate - Gate shall be cast or ductile iron encapsulated in Buna-N rubber or nitrile elastomer.
- F. Types of End Connection - End connections may be either flanged, push-on, or mechanical joint type per Section 33 11 13.13 or Section 33 11 13.23.

2.2 Gate Valves three Inches and Smaller -

- A. Aboveground Valves - Aboveground threaded end gate valves, 1/4-inch through 3 inches for water service, shall be nonrising stem, screwed bonnet, solid wedge disc type having a minimum working pressure of 220 psi. The body, bonnet, and stem shall be of bronze, ASTM B 62. Handwheels shall be of brass. Packing shall be Teflon asbestos.
- B. Buried Valves - Buried gate valves for water service shall be iron body, bronze mounted, nonrising stem type, double disc, parallel seat, and shall have a working pressure of at least 200 psi.

Valves shall have flanged or threaded ends to match the pipe ends. Valves supplied with threaded ends shall not be in direct contact with the soil.

Valves shall have a two-inch AWWA operating nut.

Bonnet and stuffing box bolts shall be cadmium plated steel. Discs, disc nut, disc ring, and seat ring shall be bronze.

3.0 EXECUTION

3.1 Storage - Valves shall be delivered and stored in the field with the port openings covered with plastic, cardboard or wood. These covers shall remain in place until the valve is ready to be installed. Valves shall not be stored in contact with bare ground. Valves shall not be stacked on top of one another.

3.2 Installation - The weight of the valve shall be supported by firm ground or concrete blocking and not by the pipe. Buried valves having the top of the operating nut greater than three feet below the finished surface shall be provided with shaft extensions.

A. Flanged Connection - Boltholes of flanged valves shall straddle the horizontal and vertical axis of the pipe to which the valves are attached. Flanges, bolts and nuts shall be cleaned by wire brushing before installing flanged valves. Threads on nuts and bolts shall be lubricated with oil and graphite. Nuts and bolts shall be tightened uniformly and progressively. If flanges leak under pressure testing, the contractor shall loosen or remove the nuts and bolts, reseal or replace the gasket, reinstall or retighten the bolts, and retest the joints. Joints shall be watertight.

Bolts shall be tightened in an even manner by a series of steps until the torque required by the manufacturer is reached.

B. Threaded Connection - Threaded joints shall be cleaned by wire brushing or swabbing. Teflon joint compound or Teflon tape shall be applied to pipe threads before installing threaded valves. Joints shall be watertight.

C. Push-on Connection - Rubber ring grooves of joints shall be inspected before installation by the contractor for ridges or holes that would interfere with the rubber ring. Interferences with the rubber rings shall be corrected to a satisfactory condition or the valve replaced, as required by the District.

The pipe to be stabbed into the valve shall be beveled. Pipe shall be stabbed into the valve to the "Insertion Depth" as specified by the manufacturer.

D. Mechanical Joint - Valve socket, gland, and pipe plain end shall be wiped clean of all sand, dirt and other foreign material prior to valve installation. Bolts shall be tightened in a manner by a series of steps until the torque required by the manufacturer is reached.

- E. Polyethylene Encasement - Valves and all bolted connections shall be encased with 10 mil polyethylene plastic film wrap installed as follows: The valves shall be wrapped by passing the flat sheet of film under the valve bottom and bringing the ends up around the body to the stem and securing it in place with two-inch strips of the plastic adhesive tape. The polyethylene shall be secured around the valve stem in such a manner as to leave the stem free to operate. The film shall be brought completely around the flanges and secured to the pipe with a plastic adhesive tape on either side of the valve, flange or fitting.

- F. Operation - Immediately before installation, each valve shall be operated through one complete open-close cycle and visually checked for proper operation. Boxing of valves shall begin immediately after pipe sections containing the valve have been installed. All valve boxes, paving rings, and lids shall be brought to grade after pavement has been constructed.

END OF SECTION

BUTTERFLY VALVES

1.0 GENERAL

- 1.1 Scope - This specification governs materials and installation of butterfly valves. Valves greater than 12 inches shall be butterfly valves.

Valves shall be furnished and installed by the contractor at the locations shown on the approved plans, or as required by the District.

- 1.2 Submittals - Prior to the purchase of butterfly valves to be used in the District system, the following items shall be submitted and approved by the District.

- A. Manufacturer's catalog data and detail construction sheets showing the size to be used, valve dimensions, pressure rating and materials of construction.
- B. Actuator manufacturer's catalog data and detail construction sheets showing the dimensions, materials, number of turns, and required torque input of the actuator to be used.
- C. Manufacturer's catalog data and NSF certification seal on the lining to be used.

2.0 MATERIALS

- 2.1 General - Butterfly valves shall be tightly closing, rubber seated valves conforming to AWWA C-504 suitable for buried service. Valves shall be Class 150-B designed for tight shut-off up to 150 psi in both directions. Valve disc shall rotate 90 degrees from fully open to tightly closed position.

- A. Valve body - Valve bodies shall be cast iron with integrally cast mechanical joints or flanged ends. Exposed capscrews, bolts, and nuts shall be stainless steel type 304.
- B. Valve operators - Shall be of the manual traveling nut type. Operators shall be equipped with a two-inch AWWA square operating nut. They shall be sealed and gasketed and lubricated for underground service. The operator shall be capable of withstanding an input torque of 450 ft. lbs. at extreme operator position without damage.

Gear operators for valves located above ground or in vaults and structures shall have handwheels. The handwheel shall have a minimum diameter of 12 inches. The actuator shall contain a dial indicator which shows the position of the valve disc.

- C. Coating and Lining - Interior surfaces, excluding seating areas, bronze, and stainless steel pieces, shall be epoxy lined to a dry film thickness of 12 mils. Liquid epoxy linings shall be applied in two coats. Lining of interior valve surfaces shall be performed in a facility with qualified personnel and where the environment can be controlled. Epoxy lining of valves shall not be permitted in the field. Liquid epoxy coating materials shall be listed in the NSF Listing for Drinking Water Additives, Standard 61, as certified for use in contact with potable water. Powder epoxy coating materials shall contain 100% solids. Surface preparation shall include White Metal Blast Cleaning.

Exterior surfaces shall be shop coated with two coats of asphalt varnish conforming to AWWA C-504. Flange faces shall be coated with a rust preventive compound.

- D. Marking - The manufacturer shall show on the valve the valve size, manufacturer, class and year of manufacture.
- E. Valve Disc and Shaft - Discs shall be cast iron with a stainless steel edge. Shafts shall be type 304 stainless steel.
- F. Types of End Connections - End connections may be either flanged or mechanical joint type per Section 33 11 13.13 or Section 33 11 13.23.

3.0 EXECUTION

- 3.1 Storage - Valves shall be delivered and stored in the field with the port openings covered with plastic, cardboard or wood. These covers shall remain in place until the valves are ready to be installed. Valves shall not be stored in contact with bare ground. Valves shall not be stacked on top of one another.

- 3.2 Installation - The weight of the valve shall be supported by firm ground or blocking and not the pipe.

- A. Flanged Connection - Valves shall be installed with the operating nut in the vertical position. Flanges, bolts and nuts shall be cleaned by wire brushing before installing flanged valves. Threads of bolts and nuts shall be cleaned by wire brushing, and threads shall be

lubricated with oil and graphite. Nuts and bolts shall be tightened uniformly and progressively. If flanges leak under pressure testing, the contractor shall loosen or remove the nuts and bolts, reseal or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

Bolts shall be tightened in an even manner by a series of steps until the torque required by the manufacturer is reached.

- B. Mechanical Joint - Valve socket, gland, and pipe plain end shall be wiped clean of all sand, dirt and foreign material prior to valve installation. Bolts shall be tightened in a manner by a series of steps until the torque required by the manufacturer is reached.
- C. Polyethylene Encasement - Valves and all bolted connections shall be encased with 10 mil polyethylene plastic film wrap installed as follows: The valves shall be wrapped by passing the flat sheet of film under the valve bottom and bringing the ends around the body to the stem and securing it in place with two-inch strips of adhesive tape. The polyethylene shall be secured around the valve in such a manner as to leave the stem free to operate. The film shall be brought completely around the flanges and secured to the pipe with a plastic adhesive tape on either side of the valve flange.
- D. Operation - Immediately before installation, each valve shall be operated through one complete open-close cycle and visually checked for proper operation. Boxing of valves shall begin immediately after pipe sections containing the valves have been installed. All valve boxes, paving rings, and lids shall be brought to grade after pavement has been constructed.

END OF SECTION

TAPPING VALVES AND SLEEVES

1.0 GENERAL

- 1.1 Scope - This section governs materials and installation of tapping valves and sleeves. Valves shall be furnished and installed by the contractor at the locations shown on the Approved Plans, or as required by the District.
- 1.2 Submittals - Prior to the purchase of tapping valves and sleeves to be used in the District system, the following items shall be submitted to and approved by the District:
 - A. Manufacturer's catalog data and detail construction sheets showing the size to be used, valve and sleeve dimensions, pressure rating and materials of construction.
 - B. Manufacturer's catalog data and NSF certification seal on the lining to be used.

2.0 MATERIALS

- 2.1 Tapping Valves - Tapping valves shall be of the double disc or resilient seat type conforming to all requirements for gate valves in Section 40 05 61. Valves shall be furnished with a flanged end with centering ring on the tapping sleeve side. The outlet side of valve shall have a mechanical joint, except as otherwise approved. Seat rings shall be oversized to permit the use of full-size cutters.
- 2.2 Tapping Sleeves - Sleeves shall be 304 stainless steel or cast iron conforming to ASTM-A-126 Class B. Bolts, nuts, and washers shall be type 304 stainless steel. Gaskets shall be Buna-N rubber at each end of the sleeve. Sleeves shall have ¾-inch NPT plug for air test.
- 2.3 Coating and Linings - Valves shall be coated and lined per Section 40 05 61. Cast iron sleeves shall be coated with two coats of asphalt varnish conforming to AWWA C504, except for face of flanges, bolts and nuts. Face of flanges shall be shop coated with a rust preventive compound.

3.0 EXECUTION

- 3.1 Installation - Surface preparation, sleeve placement, and connection of valve shall be in accordance with manufacturer's recommendations. Method of installation may vary depending on type of pipe being tapped.

- 3.2 Testing - Valve and sleeve shall be air tested prior to pipe cutting. Valve and sleeve shall sustain an air pressure of 30 psi for 5 minutes. After acceptance of the air test the pipe can be tapped.
- 3.3 Tapping - Tapping shall only be done in the presence of the Inspector. The tapping mechanism shall be of the self-purging type so that cutting chips are removed from the tapping machine and do not enter the pipeline.
- 3.4 Size - The diameter of the tap shall be less than the diameter of the main being tapped.

END OF SECTION

AIR AND VACUUM VALVE ASSEMBLIES

1.0 GENERAL

- 1.1 Scope - This specification governs materials and installation for air release, air and vacuum, or combination air-vacuum and air release valve assemblies. The type of air valve to be installed shall be as indicated on the plans. Valve assemblies include all items from the main pipeline to the valve vent as shown on the Standard Drawings.
- 1.2 Submittals - Prior to the purchase of valves to be used in the District system, the following items shall be submitted and approved by the District:
- A. Manufacturer's catalog data showing valve type and size to be used, valve dimensions, pressure rating and materials of construction.

2.0 MATERIALS

- 2.1 Valves - Valve bodies shall be of high strength cast iron. The float, seal, and all moving parts shall be of Type 316 stainless steel. Seat washers and gaskets shall be of Buna-N, Nitrile Rubber. Valves shall be designed for a minimum pressure of 150 psi unless otherwise shown. Valves shall be designed to perform the following function:
- A. Air Release Valve - Air release valves shall be designed to release small amounts of air that can accumulate at high points in systems once they are filled and under pressure.
 - B. Air and Vacuum Valves - Air and vacuum valves shall be designed to: (1) expel large amounts of air from a system when it is being filled, (2) remain closed when the system is in operation and under pressure, and (3) open to allow air to enter when the line begins to drain and the internal pressure reverts to atmosphere.
 - C. Combination Air-Vacuum and Air Release Valves - These valves combine the features of the air release, and the air and vacuum valves specified herein.
- 2.2 Appurtenances - Materials for gate valves, piping, boxes, and fittings shall conform to the requirements of Section 33 12 13 and as shown on the Standard Drawings.

3.0 EXECUTION

- 3.1 Installation - The tap for the air valves shall be made in a level section of pipe no closer than 18 inches to a bell, coupling, joint, or fitting.

Tapping mains shall conform to the standard procedures for house services.

Air valve assemblies shall be installed in accordance with the Standard Drawing.

Threaded joints shall be cleaned by wire brushing or swabbing. Teflon joint compound or Teflon tape shall be applied to pipe threads before installing threaded valves. Joints shall be watertight.

Dielectric connections with PVC tape wrap shall be provided at all connections between steel or iron and brass or bronze. Copper, brass, and other nonferrous metal pipe shall be isolated from steel or cast iron by insulated couplings or unions.

The contractor shall also isolate nonferrous pipe from steel supports and pipe straps by means of insulating sleeves or tape wrapped around the pipe.

- 3.2 Testing - Air valve assemblies shall be tested at the same time that the connecting pipelines are pressure tested.

END OF SECTION

FIRE HYDRANT ASSEMBLIES

1.0 GENERAL

- 1.1 Scope - This specification governs materials and installation for fire hydrant assemblies. Fire hydrant assembly includes all items from the main line tee to the fire hydrant as shown on the Standard Drawings.
- 1.2 Submittals - Prior to the purchase of fire hydrants to be used in the District's system, the following items shall be submitted and approved by the District:
- Manufacturer's catalog data showing model, size, dimensions, and materials of construction.

2.0 MATERIALS

- 2.1 Fire Hydrants - Fire hydrants shall be dry barrel type meeting AWWA C502 and have a 6-inch bell inlet with two 2 ½-inch hose outlets and one 4½-inch pumper connection. Threads on the pumper and hose connections shall conform to the requirements of the fire department equipment of the area which they are to serve or if no standards exist, they shall conform to the "National Standard Screw Threads for Fire Hose Couplings and Fittings" published by the National Board of Fire Underwriters. Hydrants shall be designed to operate at a minimum of 200 psi working pressure and shall be tested hydrostatically to 400 psi. Fire hydrants shall open to the left (counterclockwise). The hydrant shall be cast iron and bronze mounted. Hydrants shall have a main valve opening size of 4 ½ inches. The outlets shall be protected with caps attached to the hydrant head with a chain. Other specific requirements are:
- Hydrant materials shall comply with AWWA C502.
 - Hydrant flanges shall contain six equally spaced bolt holes of 7/8-inch diameter on a 9 3/8-inch diameter.
 - All hydrants shall be permanently marked with the manufacturer's name and the year of the manufacture.
 - Caps shall be metal-type.
- 2.2 Hydrant Lateral - Six-inch DI or PVC pipe shall be used. Hydrant laterals shall be pressure rated appropriately. Thrust block sizes shall be as shown in the Standard Drawings.

- 2.3 Hydrant Lateral Valve - The lateral valve shall be a six-inch gate valve. The valve shall be stacked to the surface as shown on the Standard Drawings.
- 2.4 Spools and Bury - Hydrant burys shall be six inches inside the diameter and made of cast iron conforming to ASTM A-126. The burys shall be one piece with the top having a flange drilled with six holes to receive the extension spool or hydrant. The bottom shall have a 90 degree bend. The bury end shall be a push joint or mechanical joint fitting.
- 2.5 Bolts - Alloy steel break-off bolts shall be used to attach the fire hydrant to the extension spool.

3.0 EXECUTION

- 3.1 Examination of Material - Prior to installation, all hydrants shall be inspected for direction of opening, nozzle threading, operating-nut and cap-nut dimensions, tightness of pressure-containing bolting, cleanliness of inlet elbow, handling damage, and cracks. Defective hydrants shall be corrected or held for inspection by the District.
- 3.2 Placement of Hydrant - All hydrants shall stand plumb and shall have their nozzles parallel with or at right angles to the curb, with pumper nozzle facing the curb.
- 3.3 Assembly Installation - Special attention is called to the following:
- The shoe of the fire hydrant bury must be anchored on a concrete thrust block.
 - The fire hydrant shall be positioned so that the bolts between the extension piece and the hydrant are accessible, both top and bottom, within the limits shown on the Standard Drawing. If the hydrant is either too low or too high, it shall be corrected.
 - Painting shall be per Section 09 90 00 with all metal surfaces above ground being painted, including any extensions. The extension piece shall be painted before installation. Color of hydrant will be determined by the local fire department.
 - All underground iron fittings shall be wrapped with polyethylene.
- 3.4 Testing - Hydrants are to be tested at same time with the main. Dry-barrel hydrants shall have the drain valves tested in the following manner:
- Following the pressure test, open fire hydrant valve a few turns and allow hydrant to fill until water is at bottom of nozzle. Close hydrant valve and observe water level drop. If drop in water level is not visible, place palm of hand over open nozzle to feel a noticeable suction. If

water level drop is not detectable, the hydrant has failed the drainage test.

- If the hydrant fails the drainage test, the drain valve may be clogged or backfill material does not permit free drainage. The contractor shall make the necessary corrections and repairs to correct improper drainage.

END OF SECTION