# YORBA LINDA WATER DISTRICT

## STANDARD SPECIFICATIONS AND DRAWINGS

## FOR

## CONSTRUCTION OF DOMESTIC WATER AND SEWER FACILITIES

Yorba Linda Water District

**APRIL 2026**

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**STANDARD SPECIFICATIONS**
**TABLE OF CONTENTS**

# SECTION 00500

# DESIGN CRITERIA FOR DOMESTIC WATER FACILITIES

## 500.1 PIPE SIZE CRITERIA

The minimum size distribution main shall be an 8-inch looped line.

On dead end streets, the minimum size main shall be 8 inches to at least the last fire hydrant.

Dead-end mains without fire hydrants may be of smaller than 8-inches as approved by the Engineering Manager. These mains shall be sized so that sufficient water is regularly drawn to prevent stagnation.

## 500.2 STORAGE CRITERIA

Water services and connections shall be provided from potable water elevated (gravity) storage only.

## 500.3 DESIGN FLOW CRITERIA

Use 235 gallons/per capita per day for residential average day domestic flow demand.

## 500.4 WATER MAIN PIPE MATERIAL

### 500.4.1 Residential Areas (Distribution Mains)

Pressure Class 305 polyvinyl chloride (PVC) pipe in accordance with AWWA C900 or AWWA C909 is to be used for distribution mains up to and including 12-inch diameter. Distribution mains within unpaved easements shall be PVCO C909.

### 500.4.2 Transmission Mains

Pipe greater than 12-inch shall be cement mortar lined and coated (CML&C) steel pipe. PVC may be allowed up to 16-inch with permission from the Engineering Manager and use of external thrust restraint system.

## 500.5 MINIMUM DEPTH TO TOP OF WATER MAIN PIPE

### 500.5.1 Residential Areas (Distribution Mains up to and including 12-inch in diameter)

The top of the pipe is to be a minimum of 36 inches below the finished street grade unless indicated otherwise on plans or directed otherwise by the District Inspector because of unusual field conditions.

### 500.5.2 Transmission Mains (greater than 12-inch in diameter)

The top of the pipe is to be a minimum of 48 inches below the finished street grade unless indicted otherwise on plans or directed otherwise by the District Inspector because of unusual field conditions.

## 500.6 STANDARD LOCATION

Domestic water main centerlines shall normally be located 6 feet from the northerly or easterly curb face, and shall be deflected to avoid cross gutters, concrete bus lanes or other interference.

## 500.7 WATER VALVES

### 500.7.1 Water Valve Spacing

As a rule, there should be three isolation valves where one main ties into another (e.g., tee). Where two mains cross, there shall be four valves. On long blocks, intermediate valves should be installed so that only a maximum of 18 lots or 600 feet, whichever is less, would have to be shut off at any one time.

Valves should also be spaced so that not more than two fire hydrants or fire service lines, or any combination of two, should be cut out of service at any one time.

Where water mains pass through easements outside traveled streets, a valve shall be located at each end of the easement. The final determination of valves and locations shall be per the Engineering Manager.

### 500.7.2 Water Valve Selection Criteria

Wedge-type resilient-seated, gate valves shall be used for water mains smaller than 12-inches in diameter. Butterfly valves shall be used for water mains 12-inches in diameter and greater.

## 500.8 SEPARATION BETWEEN WATER AND SEWER AND STORM DRAINS

### 500.8.1 Horizontal Separation

State Water Resources Control Board regulations require a 10-foot minimum separation between water and sewer mains. Sewer mains refer to any pipeline conveying untreated sewage, primary or secondary treated sewage, disinfected recycled water and hazardous fluids such as fuels, industrial wastes, and wastewater sludge.

Separation requirements between water and pipelines conveying disinfected tertiary recycled water, storm drainage, or raw water to be treated for drinking purposes shall be a 4-foot minimum.

However, in special situations where there is no alternative but to install the mains with less than the required separation, special construction will be considered on an individual basis by the District. A separate application for State Water Resources Control Board approval is required. Minimum horizontal separation of domestic water service line and sewer lateral shall be 5 feet.

### 500.8.2 Vertical Separation

Normally, water and wet utilities shall be located vertically from the street surface in order of the higher quality; i.e., water shall be above the sewer.

Whenever a crossing must occur where a non-potable water, storm drain or sewer main passes within 1 foot of a water main, special construction will be considered on an individual basis by the District. A separate application for State Water Resources Control Board approval is required.

One of the following types of alternates may be required contingent upon State Water Resources Control Board approval:

1. Reinforced concrete encasement, a minimum thickness of 6 inches.

2. Piping within a continuous steel casing, which shall have a thickness of not less than ¼ inch and with all voids between pipe and casing pressure filled with air blown sand.

If a pipeline listed in Section 500.8.1 is above a water main, the special construction shall extend a sufficient distance on both sides of the crossing to provide a minimum of 10 feet of horizontal clearance. If a pipeline listed in Section 500.8.1 is located below a water main, and within a vertical distance of a 1 foot clearance distance, the special construction shall extend a sufficient distance on both sides of the crossing to provide 4 feet of horizontal clearance. A separate application for State Water Resources Control Board approval is required. These construction requirements shall not apply to those laterals that cross perpendicular less than 1 foot below a pressure water main.

Proposed domestic water service lines shall have a minimum 1 foot vertical separation when crossing over proposed sewer laterals.

## 500.9 WATER SUPPLY FOR FIRE PROTECTION

The Orange County Fire Authority (OCFA) is the agency responsible for establishing fire flow requirements for the District's service area. The OCFA fire flow requirements are based on the fire flow requirements listed in the latest edition of the California Fire Code. The design criteria to be used for determining fire flow requirements shall be the **actual fire flow requirements as determined by the Orange County Fire Marshal**. Before designing the domestic water system for a project, the applicant shall obtain the Orange County Fire Marshal's fire flow requirements for the project. These requirements, plus the Fire Marshal's signed approval, are required prior to the District's approval. All fire flow tests shall be performed by an independent tester and witnessed by the District.

The capacity of all supply facilities shall be sufficient to deliver the required fire flow for the specified duration. Storage facilities can offset the requirements.

(1) Fire Flow Requirements - Fire flow analysis, pipe sizing and fire hydrant location shall be approved by the Orange County Fire Authority prior to approval of domestic water plans.

(2) Pipe Sizing – The size of distribution system piping shall be sufficient to deliver the required fire flow during maximum daily consumption conditions. Minimum size piping satisfactory for fire hydrant service is six inches (6"). Dead end mains serving fire hydrants should be eight inches (8") or larger. As a feature of reliability, distribution systems should be well looped.

(3) Gate Valve Spacing – Distribution piping should be gated such that not more than two (2) fire hydrants or fire service lines are removed from service in the event of a break in piping.

(4) Fire Hydrant Spacing – Hydrants shall be spaced along street fronts not to exceed 300 feet spacing for residential developments. Supplemental fire hydrant protection may be required for deep lot properties. Fire hydrant spacing shall be approved by OCFA.

(5) Fire Hydrant Size – Approved cast iron or ductile iron wet barrel hydrants are satisfactory. Hydrants shall have a six inch (6") branch connection to the main and a valve on the branch connection. Hydrant barrels shall be 6 inches with one 4-inch pumper outlet and one 2½-inch outlet for low density residential use, and one 4-inch pumper outlet and two 2½-inch outlets for high density residential and commercial use.

## 500.10 SERVICE MATERIALS AND MINIMUM SERVICE SIZE

### 500.10.1 General

Approved materials and manufacturers for various service material tubing and connections are listed in the District's Standard Drawings W-1 and W-2.

### 500.10.2 Minimum Domestic Service Size

Minimum domestic service size shall be 1-inch. Commercial, irrigation or industrial service size is to be as shown on plans or as directed by the Engineering Manager.

### 500.10.3 Type of Service Tubing

Acceptable service tubing is as follows: 1-inch, 1½-inch and 2-inch, Copper, Type L, M, K, per Standard Specification Section 15057, Copper Pipe and Fittings. No Exceptions.

### 500.10.4 Meters

All residential meters, industrial, commercial and individual service meters will be furnished and installed by the District, subsequent to payment of all applicable charges.

## 500.11 STANDARD WATER NOTES

Standard water notes to be included on all street improvement plans or water system construction plans shall be as follows:

1. The water system as shown on these plans shall be constructed in accordance with Yorba Linda Water District's Standard Specifications and Drawings for Construction of Domestic Water and Sewer Facilities, Latest Edition. Contractor shall keep a copy of the standard specifications and drawings on the jobsite at all times.

2. The District shall be notified at least 48 hours prior to commencing work and for scheduling inspections on the water improvements. **Phone: (714) 701-3100**, for inspection. No facility shall be backfilled until inspected by the District.

3. A preconstruction meeting conference of representatives from affected agencies and the Contractor shall be held on the job site at least 48 hours prior to start of work.

4. The Contractor shall notify Underground Service Alert (Dig Alert) at least two (2) working days prior to construction at 811 or 1-800-422-4133.

5. To report a water or sewer main break, leak, or other damage to District facilities, call (714) 701-3000.

6. Approval of this plan by Yorba Linda Water District does not constitute a representation as to the accuracy or completeness of the location or existence or non-existence of any underground utility pipe or structure within the limits of this project. The Contractor is required to take all due precautionary means to protect the utility lines not of record or not shown on this plan. Contractor performing work on this project shall become familiar with this site and shall be solely responsible for any damage to existing facilities resulting directly from construction operations.

7. In accordance with California Code of Regulations, Title 8, Section 341 (Permit Requirements) the Contractor shall obtain a permit from the State of California Division of Industrial Safety prior to any trench excavation. A copy of said permit shall be kept at the job site and available to the District Representative upon request.

8. Contractor shall replace in kind all improvements removed or disturbed during construction unless otherwise noted.

9. The water system shall be installed a minimum of 1 week after all curbs have been installed. If there are no curbs planned, then the water system shall be staked by the Developer's Engineer at a minimum 50-foot stationing at no cost to the District.

10. Any water service found to be within a driveway shall be removed completely from the corporation stop and reinstalled at the proper location, at no cost to the District.

11. All main line valves shall be maintained so as to be accessible during tract development, and all valve stem tops having over 84 inches of cover will require an extension. See Standard Drawing W-9.

12. In residential streets, the top of the pipe 12 inches and smaller shall be a minimum of 36 inches below the finished street surface and 48 inches below finished street surface for pipe greater than 12 inches.

13. All wet-barrel fire hydrants shall be set with the bottom of the top flange of the break-off riser 3 inches above the concrete pad or sidewalk. See Standard Drawing W-21.

14. Blue reflector dots shall be installed in streets adjacent to all fire hydrant installations, per Standard Drawing W-23.

15. Actual Fire Hydrant installation location shall have a minimum of 5 feet radius unobstructed clearance all around.

16. Existing dry-barrel fire hydrants that require relocation or replacement shall be replaced with wet-barrel fire hydrants. See Standard Drawing W-21.

17. All water mains 6 inch through 12 inch diameter shall be PVC C900 CL 305, unless otherwise noted. Larger than 12 inch shall be steel cylinder CML&C, unless otherwise noted. PVC may be used for pipes up to 16-inches in diameter with use of an external restraint system and Engineering Manager approval.

18. No taps or other connections shall be made to existing District water mains prior to conducting an approved pressure test and bacteria test on the new water distribution system. Tapping sleeves shall be pressure tested in an approved manner in the field in the presence of the District Inspector, prior to tapping the main line. Tapping of the main line shall not proceed unless a District Inspector is present.

19. All fittings shall be minimum 200 psi rating.

20. Where meters and meter boxes are located within slopes, the angle meter stops shall be so located that the meters and boxes will be parallel and flush, respectively, with the finished surface.

21. Curbs shall be inscribed with a "W" indicating locations of all domestic water services.

22. After new potable water improvements are installed and approved by the District, these improvements are considered to be connected to the existing water system. Therefore, all newly installed valves, including existing valves, shall be operated by authorized District employees only. Contractor shall notify the District at least two (2) working days prior to valve operation at (714) 701-3100.

23. All buried nuts and bolts shall be Type 316 stainless steel.

24. After installation, all buried nuts, bolts and flanges shall be coated with two coats of 10 mils each of NO-OX-ID Soft Grease by Sanchem, Inc., wax tape material, or approved equal.

25. Disinfecting of pipe shall be in accordance with YLWD Standard Specification 15041, Chlorination of Water Mains for Disinfection.

26. Pipeline shall be pressure tested in accordance with YLWD Standard Specification 15042, Hydrostatic Testing of Pressure Pipelines.

27. Stations shown are along the horizontal centerline of the pipe.

28. Individual pressure regulators shall be required by jurisdictional agency if average static pressure is 80 psi or greater.

29. All valves shall be installed clear of all spandrels and gutters within streets.

30. Where valves are located, curbs shall be inscribed with a "V" and the distance to the valve in two (2) locations.

31. All water services for landscaping, agricultural, commercial and industrial buildings shall have a reduced pressure principle backflow assembly, per Standard Drawing W-18.

32. All residential buildings required by the Orange County Fire Authority to install a fire sprinkler system, shall have a double check valve backflow assembly. See Standard Drawing W-19.

33. All fire detector assemblies and backflow devices shall be tested after installation by a certified tester licensed to operate in Orange County.

34. All water main crossings of sewer lines shall conform to the requirements of the State Water Resources Control Board, Division of Drinking Water.

35. Before final acceptance of the work by the District, the Contractor shall furnish "AS-BUILT" plans to the District at the completion of the work.

36. The contractor shall notify the District one (1) week prior to any proposed shut down of existing mains or services. Contractor shall expose pipeline a day prior to cut-in. Contractor shall complete all work within an eight (8) hour period for the scheduled shut down.

37. Abandonment of water facilities shall be in accordance with YLWD Standard Specification 01045, Existing Facilities.

38. The Contractor shall complete and submit District Form R8-2009-0003, De Minimus Waste Discharge Report to the District Engineering Department within 24-hours of discharging waste water to the storm drain system for water-related construction. The form is available at the District website, ylwd.com.

39. In accordance with the latest District Rules and Regulations for Water Service, jumpers are not permitted. After onsite rough grading, water main, services, curb, gutter and base paving are complete, the meter shall be set by the District.

## 500.12 MISCELLANEOUS STANDARD GUIDELINES

1. Separate quantity estimates shall be listed on the plans indicating type/quantity of pipe, valves, fire hydrants, domestic water services, etc.

2. A plan and profile is required on drawings for all water mains, unless otherwise directed by the District.

3. The drawing shall show on plan and profile the position of all other known underground utilities or proposed underground utilities. (Top and bottom of pipe elevations may be required in addition.)

4. Fire hydrants shall be installed at end of all mains and large service stub-outs for testing and flushing purposes.

5. Air and vacuum valves shall be installed at all high points in the line for pipes 8-inches in diameter or greater. See Standard Drawing W-10.

6. Blow-off assemblies shall be installed at all low points in the line for pipes 8-inches in diameter or greater. See Standard Drawing W-27.

7. Minimum separation of domestic water service lines shall be 3 feet when on the same side of the water main and 1.5 feet when on opposite sides of the water main.

8. Generally the District requires all fittings and valves to have "RT" or "MJ" type ends, except at tees and crosses where valves are required. Where a valve is required, the valve and fitting are to be joined by a flange.

9. All plans shall have 1" = 100′ index map showing all water and sewer lines, valves, fire hydrants, manholes and cleanouts.

10. The minimum slope of water mains shall be 0.001.

11. Fittings, valves and water service saddles shall have a minimum pipe clearance of 24 inches from other appurtenances, including pipe bell or collar.

12. Easement dimensions for water improvements are as follows:

    a. Water main pipelines shall have minimum 15'-wide easements, centered on the pipeline.
    b. Water service lines and meters shall have minimum 3'-wide easements, centered on these facilities. The easement shall extend 2.5' from back of the water meter.
    c. Fire hydrants and their laterals/run shall have minimum 10'-wide easements that extend 5' back from the fire hydrant centerline.
    d. Combination air vacuum-air release assemblies shall have minimum 5'-wide easements that extend 2.5' back from the assembly centerline.

13. Per California Code of Regulations, Title 22, Section 64591 (Indirect Additives), a water system shall not use any chemical, material, lubricant, or product in the production, treatment or distribution of drinking water that will result in its contact with the drinking water including process media (carbon, sand), protective materials (coatings, linings, liners), joining an sealing materials (solvent cements, welding materials, gaskets, lubricating oils), pipes and related products (pipes, tanks, fittings), and mechanical devices used in treatment/transmission/distribution systems (valves, chlorinators, separation membranes) that has not been tested and certified as meeting the specifications of National Sanitation Foundation/American National Standards Institute (NSF/ANSI) 61-2005 / Addendum 1.0-2005 (Drinking Water System Components—Health Effects), which is hereby incorporated by reference. This requirement shall be met under testing conducted by a product certification organization accredited for this purpose by the ANSI.

**END OF SECTION**

# SECTION 00600

# DESIGN CRITERIA FOR SEWER FACILITIES

## 600.1 MINIMUM SIZE

The District will not accept for maintenance sewer lines smaller than 8 inches nor any sewer line that is within a common trench (two or more utilities in the same trench).

## 600.2 MINIMUM AND MAXIMUM SLOPE DESIGN

### 600.2.1 Slopes

All sewers shall be designed and constructed to give mean velocities, when flowing half full at the estimated peak flow, of not less than 2.0 fps, based on Manning's formula using an "n" value of 0.013. The following are minimum slopes; however, slopes greater than these are desirable. The District reserves the right to require greater slopes where deemed necessary.

| Sewer Size (inches) | Minimum Slope in Feet per 100 Feet |
|---|---|
| 8 | 0.40 |
| 10 | 0.28 |
| 12 | 0.22 |
| 15 | 0.16 |
| 18 | 0.12 |
| 21 | 0.10 |
| 24 | 0.08 |

Maximum slopes shall be 15% unless authorized by the District.

### 600.2.2 High Velocity Protection

Where flow velocities greater than 8 fps are attained, special provisions shall be made to protect against displacement by erosion and shock for pipe entering a manhole and for concrete manhole base and flow channels.

## 600.3 FLOW DESIGN CRITERIA

### 600.3.1 Criteria for Average Daily Flow Calculations

The following table summarizes the average unit flow factor for various land uses. Sewerage generation rates for land uses not shown shall be established by the District.

| Unit Flow Factor for Various Land Uses | |
|---|---|
| **Land Use** | **Average Unit Flow Factor** |
| Residential – Low Density | 295 gpd/dwelling unit |
| Residential – Medium Low Density | 281 gpd/dwelling unit |
| Residential – Medium Density | 180 gpd/dwelling unit |
| Residential – Medium High Density | 170 gpd/dwelling unit |
| Residential – High Density | 150 gpd/dwelling unit |
| Commercial - School | 2.49 gpd/student |
| Commercial - General | 1,007 gpd/acre |
| Industrial - Manufacturing | 808 gpd/acre |

### 600.3.2 Peak Flows

Pipeline design shall be based on the peak flows as determined from Manning's formula and the following: $Q_{(peak)} = 2.4 \times Q_{(avg)}^{0.95}$ where $Q_{(peak)}$ and $Q_{(avg)}$ are in gpm.

Design peak flows in pipelines 12 inches in diameter and smaller are to be limited to approximately d/D = 0.5. Pipes over 12 inches are to be limited to approximately d/D = 0.75. "d/D" is the ratio of calculated flow depth to pipe diameter.

## 600.4 SEWER PIPE MATERIAL

All gravity sewer main lines and all sewer service laterals shall be SDR 35 PVC plastic pipe unless otherwise required by the Engineering Manager. For industrial, commercial, and medical applications, extra strength vitrified clay pipe shall be used if the discharge characteristics are incompatible with PVC as determined by the Engineering Manager. Green-colored PVC C900 DR 14 or DR 18 sewer main lines shall be used for depths more than or equal to 20-feet or, as approved by the Engineering Manager. In general, gravity sewer main lines within unpaved easement areas shall be unplasticized SDR 35 PVC plastic pipe. All sewer force mains shall be of a pipe material approved by the District.

## 600.5 STANDARD LOCATION AND ALIGNMENT

### 600.5.1 Location

Wherever possible, in local residential and industrial streets, pipe is to be located 5 feet from street centerline, in the southerly or westerly direction, on the side opposite from the water main. In major, primary, and secondary highways, pipe shall be located in the center of the driving lane nearest to the center of the street. Pipe shall not be located in median strips or parking lanes. On curvilinear streets, pipe shall parallel as nearly as possible the street centerline by means of horizontal curves.

### 600.5.2 Alignment

Barring other limiting design and construction considerations, a maximum separation between sewer and domestic water mains in new subdivisions shall be achieved by the following construction procedures:

1. On curvilinear streets, the sewers shall parallel as nearly as possible the street centerline by means of horizontal curves.

2. Sewer mains should be installed on the opposite side of the centerline from the domestic water mains.

### 600.5.3 Radius of Curvature

Minimum radius of curvature in feet (horizontal) per type of pipe:

| Pipe Material | Nominal Pipe Size (inches) | Minimum Radius of Curvature | |
|---|---|---|---|
| VCP Extra Strength | 8-12 | **(5' joints)** | **(6' joints)** |
| | | 150' | 175' |
| PVC SDR 35 | 8-12 | **(14' joints)** | **(20' joints)** |
| | | 200' | 210' |

## 600.6 MINIMUM COVER

Minimum cover from finish street grade to top of sewer main pipe is to be 7 feet, unless otherwise approved by the District.

## 600.7 MANHOLE SPACING AND LOCATION

Manholes shall be installed at the end of each line; at all changes in grade, size, or alignment; at all intersections; and at distances not greater than 300 feet for 8-inch through 15-inch sewers and with Engineering Manager approval, spacing can be increased to 450 feet between manholes for 18-inch to 30-inch sewers. If sewer is curved, closer spacing of manholes will be required. Greater spacing may be permitted in larger sewers. Only one curve (horizontal or vertical) shall be allowed between any two manholes.

## 600.8 MANHOLE TYPE, MINIMUM SIZE AND DEPTH

### 600.8.1 Manhole Depth

Manhole depth is calculated from finish grade to lowest pipe invert. Minimum manhole depth is to be 8 feet. The standards for the District sewers call for a depth criteria of about 8 feet to 12 feet for manholes. However, if larger-depth manholes are required and approved by the District, the following criteria will govern. Manholes shall be pre-cast reinforced concrete with eccentric cone style. The minimum diameter of manholes shall be as follows:

| Minimum Manhole Diameter | Maximum Pipe Size with a Max. 45º Deflection | Maximum Pipe Size with a Max. 90º Deflection | Pipe Depth |
|---|---|---|---|
| 48 in. | 24 in | 18 in. | Less than 15 ft. |
| 60 in. | 36 in. | 27 in. | 15-22 ft. |
| 72 in. | 42 in. | 30 in. | Greater than 22 ft. |

Depth of manhole shall be measured from the pipe invert to the finished surface of the street with a tolerance of ± 6 inches.

For larger sized sewer mains or special circumstances, the manhole size shall be as shown on plans.

### 600.8.2 Manhole Lining

At the District's discretion, proposed and rehabilitated manholes within industrial, commercial and medical areas shall be lined with spray applied polyurethane or epoxy per the requirements of Standard Specification Section 03461, Precast Reinforced Concrete Manholes and Manhole Bases.

### 600.8.3 Allowable Head Losses

Allowable head loss in manholes shall be as follows:

1. Straight run through manholes based on 0.10 foot loss

2. Right angle turn in manholes based on 0.5 foot velocity head loss or 0.20 foot, whichever is greater

## 600.9 MANHOLE COVERS

### 600.9.1 Type of Covers

Cast-iron covers and frames shall be 24 inches, 30 inches or 36 inches in diameter as shown on the Standard Drawings with the lettering "YLWD SEWER" cast on the cover. Larger size covers may be specified for special conditions on plans. See Standard Drawing S-4.

### 600.9.2 Position of Covers

In new street developments, the manhole top shall be left at least 6 inches below subgrade. A heavy metal top with cleats the size of the manhole opening shall be mortared tight to the top. Specially cut plywood shall be placed in the bottom of the manhole before the temporary cover is installed. At the completion of final paving, the manholes shall be raised to final grade by using the necessary sized grade rings and plywood shall be removed prior to

occupancy.

## 600.10 SEPARATION BETWEEN WATERLINES AND SEWERLINES

See Subsection 600.5 herewith, and Section 500.8.

## 600.11 SINGLE-FAMILY RESIDENTIAL SERVICE CONNECTIONS (SEWER LATERALS) AND MINIMUM DEPTH AT CURB

All sewer laterals shall be located by the applicant and shown (with stationing) on the improvement plans.

Single-family residential sewer laterals shall be constructed to the property line. There shall be one sewer lateral constructed for each individually owned dwelling unit and it shall have a minimum diameter of 4 inches.

Four-inch single-family sewer laterals shall be laid to the grade as established by the applicant so that the 4-inch sewer laterals will have a minimum cover of 6 feet from the top of the curb to the top of the pipe and a minimum slope of 2% from the property line to the sewer main, per Standard Drawing S-6.

## 600.12 TOWNHOUSES AND CONDOMINIUM SERVICE CONNECTIONS (SEWER LATERALS)

For buildings containing two to four units, either one 4-inch diameter lateral to each unit or one 6-inch diameter, or larger, lateral to the building shall be used. For buildings containing more than four units, either one 4-inch diameter lateral to each unit or one 8-inch diameter, or larger, lateral to the building shall be used. A lateral shall serve only one building regardless of number of units per building.

## 600.13 GREASE INTERCEPTORS

All restaurants and other facilities which discharge an excess amount of grease into the District's sewers shall be required to install underground grease interceptors to minimize grease problems in collection systems and treatment plants. Grease interceptor sizing and installation shall conform to the latest edition of the California Plumbing Code. Grease interceptors shall be in accordance with jurisdictional agency requirements and maintained per the manufacturer's recommendations. All interceptors shall be equipped with automatic draw-off devices for easier removal of accumulated grease.

It will be the responsibility of the owner of each facility to maintain proper operating order of the interceptor unit and to remove accumulated grease at suitable intervals to avoid excessive buildup in the unit. The jurisdictional agency specifies the location of the interceptor unit. The District may periodically inspect the interceptor.

## 600.14 STANDARD SEWER NOTES

Standard sewer notes to be included on all street improvement plans or sewer system construction plans shall be as follows:

1. The sewer system as shown on these plans shall be constructed in accordance with Yorba Linda Water District's Standard Specifications and Drawings for Construction of Domestic Water and Sewer Facilities, Latest Edition. Contractor shall keep a copy of the standard specifications and drawings on the jobsite at all times.

2. The District shall be notified at least 48 hours prior to commencing work and for scheduling inspections on the sewer improvements. **Phone: (714) 701-3100**, for inspection. No facility shall be backfilled until inspected by the District.

3. A preconstruction meeting conference of representatives from affected agencies and the Contractor shall be held on the job site at least 48 hours prior to start of work.

4. The Contractor shall notify Underground Service Alert (Dig Alert) at least two (2) working days prior to construction at 811 or 1-800-422-4133.

5. To report a water or sewer main break, leak or other damage to District facilities, call (714) 701-3000.

6. Approval of this plan by Yorba Linda Water District does not constitute a representation as to the accuracy or completeness of the location or existence or non-existence of any underground utility pipe or structure within the limits of this project. Contractor shall verify the horizontal and vertical location of all utility crossings before constructing any sewers in this project. The Contractor is required to take all due precautionary means to protect the utility lines not of record or not shown on this plan. Contractor performing work on this project shall become familiar with this site and shall be solely responsible for any damage to existing facilities resulting directly from construction operations.

7. In accordance with California Code of Regulations, Title 8, Section 341 (Permit Requirements) the Contractor shall obtain a permit from the State of California Division of Industrial Safety prior to any trench excavation. A copy of said permit shall be kept at the job site and available to the District Representative upon request.

8. Contractor shall replace in kind all improvements removed or disturbed during construction unless otherwise noted.

9. The developer's engineer shall furnish the contractor and the District Inspector

sewer cut sheets which shall include "wye" stationing.

10. 0+00 shown on sewer profile denotes stationing along centerline sewer from downstream manhole.

11. The developer's engineer shall set a top of curb stake at all sewer lateral locations.

12. Where sewer manholes are not constructed within the street right-of-way, a utility marker per Standard Specification 15151 shall be set as a manhole reference.

13. All gravity sewer main lines 8 inch diameter and greater and all sewer service laterals shall be PVC, unless otherwise noted. For industrial, commercial, and medical applications, extra strength vitrified clay pipe shall be used if the discharge characteristics are incompatible with PVC as determined by the Engineering Manager. Gravity sewer main lines within easements shall be unplasticized SDR 35 PVC plastic pipe. All VCP pipe shall be bell and spigot with compression joints per Standard Specification 02710.

14. The use of Portland cement in any form will not be permitted for joints.

15. If the bottom of the existing water main does not clear the top of the new sanitary sewer main by 1 foot, alternative construction approved by the State Water Resources Control Board is required.

16. Sewer Connection: service connections are to be constructed from the sewer main to the property line for each lot. See Standard Drawing S-6.

17. Curbs shall be inscribed with an "S" indicating location of all sewer laterals.

18. Any work to be performed inside a manhole shall be done in accordance with Cal/OSHA "Confined Spaces."

19. All sewer manhole lids are to have the word "Sewer" and the initials "YLWD" cast thereon as shown in Standard Drawing S-4.

20. Manhole covers shall be left at least 6" below subgrade and brought to final grade upon completion of paving. Final manhole seating shall be 1/8" below asphalt surface.

21. Where sewer manholes are located, curbs shall be inscribed with a "MH" and the distance to the manhole in two (2) locations.

22. Final testing for sewer pipeline leakage shall be made in the presence of the District Inspector after all dry utilities are constructed and backfill has been approved and accepted by the District and/or jurisdictional agency.

23. All trench backfill shall be compacted in accordance with Standard Specification 02223, Trenching Backfilling, and Compacting, as determined by a test method required by the District or jurisdictional agency.

24. Sewer lateral connections shall not be made until the sewer has been tested for leakage and accepted by the District.

25. In order to prevent accidental use of the new sewer prior to completion and acceptance, the outlet or inlet to existing tie-in manhole(s) shall be sealed with a removable plug. Installation of these plugs shall be approved by the District. Plugs shall be removed at the time of final acceptance.

26. After final testing and manhole covers have been brought to finished asphalt surface, all sewer lines shall be balled in the presence of the District Inspector. Balling must be completed to the satisfaction of the District Inspector prior to occupancy releases being issued.

27. All new sewers shall be inspected by contractor using closed-circuit television (CCTV) equipment in accordance with Standard Specification 02701, Installation of Gravity Sewer Pipelines.

28. At the completion of the sewer work and prior to street paving, the developer's engineer shall furnish a set of "as-built" plans showing the locations of wyes and end of sewer laterals at property line to the District.

29. All sewer service connections in which the pad elevation of the property being served is lower than the rim elevation of the upstream manhole shall have a sewer backflow prevention valve. Installation of the backflow device shall comply with all requirements of the jurisdictional agency.

30. The contractor shall notify the District one (1) week prior to any proposed shut down of existing mains or laterals. Contractor shall complete all work within an eight (8) hour period for the scheduled shut down.

31. Abandonment of sewer facilities shall be in accordance with YLWD Standard Specification 01045, Existing Facilities.

## 600.15 MISCELLANEOUS STANDARD GUIDELINES

1. A plan and profile is required on drawings for all sewer mains.

2. Sewer centerline stationing shall be shown (example: 0+00) and be independent of street stationing with the stationing starting at the most downstream manhole or connection to existing sewer. All manholes are to be numbered (example: MH No. 1).

3. Sewer lateral connections shall be at least 5 ft. from the manhole structure. Sewer lateral connections to the manhole are prohibited unless otherwise approved by the Engineering Manager.

4. Lateral size shall be determined on the basis of total number of drainage fixture units, but in no case shall the lateral diameter be less than the following:

   a. 4” for single family residential buildings or individual multiple family residential units
   b. 6” for parks, multiple family residential buildings, commercial, industrial, apartment or hotel buildings.

**END OF SECTION**

**SECTION 01000**

**DEFINITIONS AND ABBREVIATIONS**

## PART 1 – GENERAL

A. Whenever the following terms, or pronouns used in their stead, or abbreviations occur in these specifications, or in any documents where these specifications govern, including without limitation the Contract Documents, the intent and meaning of such terms shall be interpreted, unless expressly provided to the contrary, as follows:

Acceptance - Acceptance means final acceptance of the Work by formal action of the Board of Directors or its authorized representative.

Accepted Proposal - The Proposal or Bid accepted by the District.

Addenda - Written or graphic instruments issued prior to the execution of the Agreement which modify, clarify or interpret the Contract Documents or Drawings and Specifications by additions, deletions, or corrections.

Bid or Proposal - The offer, bid or proposal of the Bidder for the Work when properly completed, signed, guaranteed and submitted as provided by the Contract Documents.

Bidder - Any individual, firm or corporation submitting a Proposal for the Work contemplated. A Bidder may act directly or through a duly authorized representative.

Board of Directors - The Board of Directors, or any duly authorized committee thereof, of the Yorba Linda Water District.

Change Order - A written order issued by the District's Representative to the Contractor authorizing an addition, deletion or revision in the Work within the general scope of the Contract Documents, or authorizing an adjustment in the Contract Price or Contract Time.

City - Incorporated area within the County of Orange having local governing powers.

Contract - The Contract Documents, including without limitation the written Agreement executed between the District and the Contractor.

Contract Documents - The Contract Documents consist of the Notice Inviting Bids, Information for Bidders, Proposal, Summary of Bid Schedules, Bid Bond, Information Required of Bidders, Agreement, Faithful Performance Bond, Labor and Material Bond, Certificates of Insurance, General Provisions, Special Provisions, Detail Specifications, Plans and any Addenda issued prior to the submittal of the Proposal. The Contract Documents also include any and all supplemental agreements amending or extending the Work contemplated and which may be required to complete the Work in a substantial and acceptable manner.

Contractor - The individual, firm or corporation entering into the Contract with the District for the performance of the Work required by the Contract Documents and the legal representative of said party, or the agent appointed to act for said party in the performance of the Work.

Contract Price - The Contract Price is the total price the District has agreed to pay the Contractor for completion of the Work under the Contract Documents and is synonymous with the "total bid price" of the successful Bidder.

County - The County of Orange, State of California.

Days - When used to designate a period of time, shall mean consecutive calendar days.

Defective - An adjective which, when modifying the word Work, refers to Work that is unsatisfactory, faulty or deficient, or does not conform to the Contract Documents, or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or has been damaged prior to the District Representative's recommendation of final payment.

Engineering Manager/Director of Engineering/District Engineer - The person holding the position or acting in the capacity of the Director of Engineering of the District.

District - The Yorba Linda Water District, its authorized employees, Board of Directors, and agents; also known as Agency.

District General Manager - The person holding the position or acting in the capacity of the General Manager of the District.

District's Representative - The person or firm authorized in writing by the District to represent it during the performance of the Work by the Contractor. The District's Representative means the District's Representative or his assistants.

Domestic Water (Potable Water) - That water which is pure and wholesome, does not endanger the lives or health of human beings, and conforms to the latest edition of the United States Public Health Service Drinking Water Standards, the California Safe Drinking Water Act, or other applicable standards.

Engineer/Architect - The person or firm responsible for preparing the plans, as defined below. The term "Engineer/Architect" means the Engineer/Architect or his authorized representatives.

Inspector - Any person acting on behalf of the District's Representative to perform inspection during construction of the Work.

Laboratory - The designated laboratory authorized by the District and/or its Representative to test materials and work involved in the Contract.

Legal Address of Contractor - The address given on the Contractor's bid is hereby designated as the place to which all notices, letters or other communications to the Contractor shall be mailed or delivered. The Contractor may change this address by submitting a written change of address to the District. Any such change of address shall not be deemed effective until acknowledged by the District in writing.

Notice of Award - A written communication issued by the District to the apparent successful bidder, stating that upon compliance by the apparent successful bidder with the terms and conditions set forth therein and in the Contract Documents, within the time specified, the Owner will execute and deliver the Agreement.

Notice to Proceed - A written communication issued by the District to the Contractor, authorizing the Contractor to proceed with the Work required under the Contract Documents and establishing the date of commencement of the Work.

Offsite Facilities - Shall mean facilities under the control of the District; including, but not limited to: domestic water mains, sewer mains, reservoirs, pumping stations, fire hydrants, manholes, valves, connections, supply interties, treatment facilities, and other appurtenances and property up to the point of connection with the customer's facilities.

Onsite Facilities - Shall mean facilities under the control of the applicant, owner or customer; including, but not limited to, residential, commercial, and industrial building domestic water, and sewerage systems. For domestic water, the onsite facilities shall be those downstream of the service connection, which shall normally be the downstream end of the meter tailpiece. For sewer, the onsite facilities shall be those facilities upstream from the sewerage service lateral connection to the sewer main.

Owner - Yorba Linda Water District or District

Plans - The official plans, working drawings, detail drawings, profiles, typical cross-sections and supplemental drawings, or exact reproductions thereof, approved by the Engineer/Architect, which show the locations, character, dimension, and details of the Work to be done.

Project Engineer/Project Manager – The person holding the position or acting in the capacity of the Project Engineer of the District and is the Contractor’s point of contact.

Record Drawings - Drawings which show the facilities, including all revisions to the original plans.

Site - The property upon which the Work is to be constructed and completed pursuant to the Contract Documents.

Specifications - The General Provisions, Special Provisions, Detail Specifications, Plans and any other Contract Documents which provide the directions, provisions, and requirements pertaining to the method and manner of performing the Work, and to the qualities and quantities of materials to be furnished under the Contract.

Subcontractor - An individual, firm, or corporation supplying labor or labor and materials at the Site of the Work as a part of the Contractor's obligation under the Contract.

Superintendent - The individual the Contractor is required by the Contract Documents to provide and keep on the Site to supervise the performance of the Work.

Surety - Any person, firm or corporation that executes as Surety the Contractor's performance bond, the Contractor's labor and material bond or the Contractor's bid bond.

The Work - The entire improvement proposed by the Owner to be constructed in whole, or in part, pursuant to the Contract Documents.

B. Definitions - Whenever the terms directed, required, permitted, ordered, designated, prescribed, or words of like import are used, it shall be understood that the directions, requirements, permission, order, designation, or prescription of the Owner's Representative is intended; and similarly the words approved, acceptable, satisfactory or words of like import shall mean approved by, or acceptable to, or satisfactory to the Owner's Representative, unless otherwise expressly stated.

Whenever used in these specifications, the following abbreviations shall refer to the agency shown:

| Abbreviation | Agency | Address |
|---|---|---|
| AWWA | The American Water Works Association, Inc. | 6666 West Quincy Avenue<br>Denver, CO 80235 |
| ASTM | The American Society for Testing and Materials | 1916 Race Street<br>Philadelphia, PA 19103 |
| ANSI | The American National Standards Institute | 1430 Broadway<br>New York, NY 10018 |
| CPEM | Clay Pipe Engineering Manual | National Clay Pipe Institute,<br>Western Regional Office<br>Los Angeles, CA |
| PFRD | County of Orange<br>Public Facilities & Resources Department | 300 North Flower Street,<br>Room 122<br>Santa Ana, CA 92703-3001 |
| UL | Underwriters' Laboratories, Inc. | 333 Pfingsten Road<br>Northbrook, IL 60062<br>1207 W. Imperial Highway<br>Brea, CA 92621 |
| NSF | National Sanitation Foundation | 3475 Plymouth Road<br>P.O. Box 1468<br>Ann Arbor, MI 48106 |
| SSPWC | Standard Specifications for Public Works Construction | BNI Building News<br>1612 S. Clementine St.<br>Anaheim , CA 92802 |

| Abbreviation | Agency | Address |
|---|---|---|
| OCFA | Orange County Fire Authority | 1 Fire Authority Rd., Bldg. A<br>Irvine, CA 92602 |
| SSPC | Society for Protective Coatings | 4024th Street<br>Pittsburgh, PA 15222 |
| AISI | American Iron and Steel Institute | 680 Andersen Dr.<br>Pittsburgh, PA 15220 |

## PART 2 – MATERIALS

Not Used.

## PART 3 – EXECUTION

Not Used.

**END OF SECTION**

# SECTION 01045

# EXISTING FACILITIES

## PART 1 – GENERAL

### A. Description

This section includes requirements for connection to and abandonment of existing water and sewer facilities.

### B. Related Work Specified Elsewhere

1. Trenching, Backfilling, and Compacting: 02223
2. Chlorination of Water Mains for Disinfection: 15041
3. Hydrostatic Testing of Pressure Pipelines: 15042
4. Leakage and Infiltration Testing: 15043
5. Manual Valves: 15100

### C. Location

1. The Contractor shall be responsible for determining in advance the location of all existing pipelines to which connections are to be made.
2. The Contractor shall notify Underground Service Alert of Southern California (Dig Alert) at least two working days prior to construction at 1-800-422-4133.

## PART 2 – MATERIALS

All materials used in making the connection or removing the facility from service shall conform to the applicable sections of these specifications.

## PART 3 – EXECUTION

### A. Connection to Existing Water Lines

1. Shut Down Notification: The Contractor shall give the District one (1) week advance notification prior to any proposed shut down of existing mains or services. The Contractor shall submit plan for each shut down, including schedule, duration and required District force work; i.e., closing/opening valves. The Contractor shall complete all work within an eight (8) hour period for the scheduled shut down.

2. Notice to Proceed: Connections shall be made only in the presence of the District Representative and no connection work shall proceed until the District Representative has given notice to proceed.

3. Material: The Contractor shall furnish all pipe and materials including as may be required: labor and equipment necessary to make the connections, all required excavation, backfill, pavement replacement, lights and barricades, water truck, highline hose, and fittings for making the connections. In addition, the Contractor shall assist the District in alleviating any hardship incurred during the shutdown for connections.

4. Temporary Work: Where connections are made to existing valves, the Contractor shall furnish and install all temporary blocking, steel clamps, shackles, and anchors as required by the District Representative. Valve boxes and covers shall be replaced and adjusted to the proper grade in accordance with Section 15100.

5. Dewatering: The Contractor shall dewater existing mains, as required, in the presence of the District Representative.

6. Inadequate Progress: If progress is inadequate during the connection operations to complete the connection in the time specified, the District Representative shall order necessary corrective measures. All costs for corrective measures shall be paid by the Contractor.

7. Tapping Sleeves and Valves: Tapping sleeves and valves shall be installed in accordance with Section 15100.

8. Hot Tapping Existing Water Lines:

    a. All hot tapping shall be performed by a contractor having a Class A or C-34 license.

    b. At the request of the District, contractor shall provide a list of projects and references for hot tap projects recently completed.

    c. Contractor shall provide proper notification to the District Inspector at least one (1) week advance notification prior to making a hot tap connection.

    d. Hot tap connection shall be made in the presence of a District Inspector and within normal District working hours.

    e. Contractor shall pothole the proposed connection to verify the outside diameter, location and type of pipe to be tapped prior to scheduling the hot tap.

    f. Hot tap into the existing pipe shall be made using the appropriate type of cutting equipment for the material being tapped and size of the tap being made.

g. Proper care shall be taken to prevent cutting material from entering the pipeline. The tapping coupon must be extracted.

9. Connections: Connections shall be made with as little change as possible in the grade of new main.

If the grade of the existing pipe is below that of the new pipeline, a sufficient length of the new line shall be deepened so as to prevent the creation of any high spot or abrupt changes in grade of the new line.

Where the grade of the existing pipe is above that of the new pipeline, the new line shall be laid at specified depth, except for the first joint adjacent to the connection, which shall be deflected as necessary to meet the grade of the existing pipe.

If sufficient change in direction cannot be obtained by the limited deflection of the first joint, a fitting of the proper angle shall be installed per these Specifications.

Where the connection creates a high or low spot in the line, a standard air release or blow-off assembly shall be installed as directed by the District Representative.

10. Testing: The new pipeline shall NOT be connected to an existing facility until the new pipeline has successfully passed all pressure and disinfection tests in accordance with Sections 15041 and 15042.

## B. Removal from Service of Existing Mains and Appurtenances

1. General: Existing mains and appurtenances not used in new construction shall be removed from service at the locations shown on the plans or as directed by the District Representative.

2. Method of Abandonment: Existing pipe and appurtenances shall be abandoned by the following methods. In all cases, backfill and repair of surface shall be in accordance with Section 02223, Trenching, Backfilling, and Compacting.

| Item | Allowable Demolition and Abandonment Methods | | |
|---|---|---|---|
| | Sealing Ends | Slurry Fill | Removal |
| A. Pressure Mains: | | | |
| a) 6-inch and smaller | X | X | X |
| b) Larger than 6-inch | | X | X |
| B. Gravity Sewer Mains: | | | |
| a) 6-inch and smaller | X | X | X |
| b) Larger than 6-inch | | X | X |

a. Abandonment by Sealing: Pipe section shall be cut and sealed solid with concrete to a depth of not less than one pipe diameter, forming a solid waterproof plug completely bonded to the pipe.

b. Abandonment by Slurry Filling: The abandoned pipe section shall be slurry filled by pumping a lightweight cellular concrete mixture into the pipe. The cellular concrete mixture shall be designed for void filling within abandoned pipes and have a minimum compressive strength of 50 psi unless otherwise specified by the plans or contract documents. The pipe shall be completely filled, leaving no voids or air space. The slurry shall be pumped into the pipe from the inlet end to the receiving end (exit end). Samples of the outgoing water (at exit end) shall be made until the exiting slurry mix is observed as similar to the slurry being injected at the inlet end. The cost of the testing, including labor and testing equipment shall be provided by the contractor. The slurrying plan, including the slurry mix design shall be reviewed and approved by the District Representative prior to initiating the work.

c. Abandonment by Removal: Removal of existing pipelines shall mean complete removal of the existing pipeline and disposal of the pipe and appurtenances designated as unsalvageable.

Where connections or stub-outs are abandoned, all valves shall be removed and the remaining flanged fitting shall be closed/plugged using a blind-flange fitting and thrust block.

3. Storage of Removed Material: Removed pipe and appurtenances may be temporarily stockpiled on the job in a location that will not disrupt traffic or be a safety hazard, or it may be delivered to the District yard as directed by the District Representative. In all cases the Contractor shall be responsible for the final disposal of all removed materials, including asbestos cement pipe.

4. Asbestos Cement Pipe (ACP): Asbestos cement pipe shall be removed at the joint or fitting, and disposed of in a proper manner. Field cutting of ACP is limited to snap cutting. Saw cutting is not allowed. Removal of existing ACP shall be performed by a Contractor registered by CAL/OSHA and certified by the State Contractors Licensing Board for asbestos removal. The Contractor shall comply with all State and Federal laws (including, but not limited to, South Coast AQMD Rule 1403) regarding handling and removal of asbestos materials. The Contractor shall be responsible for the proper manifesting of the ACP at an authorized disposal site. A copy of the completed manifest shall be provided to the District.

5. Maintenance of Service: Prior to performing any work to replace existing pipes and/or services, the Contractor shall make proper provisions for the maintenance and continuation of service as directed by the District Representative.

6. Abandoned Water Services: As directed by the District Representative, the abandoned water service shall have its corporation stop removed and a brass plug installed in the service saddle, and the service line crimped and abandoned in place.

At the discretion of the District, the alternate method of abandoning the water service is to remove the service saddle and corporation stop and cover the tap with a repair clamp.

If the water service is a direct tap, the corporation stop shall be removed and a repair clamp shall be installed.

If there is no corporation stop, the District Representative shall determine the method of water service abandonment.

If the water service is temporarily inactive and the service line and meter box are to remain, the angle meter stop shall be closed and locked, and the meter shall be removed and returned to the District.

7. Abandoned Sewer Laterals: Sewer laterals to be abandoned shall be cut and plugged at the main with the wye capped and encased with minimum eight (8) inches thick of concrete.

8. Abandoned Sewer Manholes: Abandoned sewer manholes shall have the grade rings and manhole cone removed and properly disposed. The manhole cover and frame shall be removed and returned to the District. All portions of the abandoned manhole shall be removed to a point six (6) feet below finished grade. The remaining portions of the manhole shall be filled with one-sack sand cement slurry.

9. Abandoned Meter Vaults, PRV Vaults and Other Structures and Boxes: These abandoned structures shall have the top hatch or covers, cover slab or hatch or box grade ring, grade rings and other structural elements removed and properly disposed. All portions of the vault shall be removed to a point six (6) feet below finished grade. The remaining portions shall be filled with one-sack sand cement slurry.

10. Abandoned Water Valves: Abandoned water valves shall be completely removed and disposed of, including the valve and stem. The valve box ring and lid shall be returned to the District.

11. Contractor shall record all abandonment, tie-ins and revision to existing facilities and submit this information to the Engineer and/or YLWD to be incorporated into the Record Drawings.

12. Contractor shall replace in kind all improvements removed or disturbed during construction unless otherwise noted.

**END OF SECTION**

# SECTION 01300

# CONTRACTOR SUBMITTALS

## PART 1 – GENERAL

### A. General

1. Wherever submittals are required hereunder, all such submittals by the Contractor shall be submitted to the Engineer.

2. Within 14 days after the date of commencement as stated in the Notice to Proceed, the Contractor shall submit the following items to the Engineer for review.

   a. A preliminary schedule of Shop Drawing, Sample, and proposed Substitutes or "Or Equal" submittals.

   b. A list of all permits and licenses the Contractor shall obtain indicating the agency required to grant the permit and the expected date of submittal for the permit and required date for receipt of the permit.

### B. Contractor's Schedule Submittal

1. Time of Submittals: Within 14 days of the commencement date stated in the Notice to Proceed, the Contractor shall submit for acceptance by the Engineer, a preliminary construction schedule for the Work, showing its general plan for orderly completion of the Work and showing in detail its planned mobilization of plant and equipment, sequence of early operations, and timing of procurement of materials and equipment. The construction schedule produced and submitted shall indicate a project completion date on or before the contract completion date. The Engineer, within 14 days after receipt of the preliminary construction schedule, shall meet with a representative of the Contractor to review the preliminary plan construction schedule.

2. Within 14 days after the conclusion of the Engineer's review period, the Contractor shall revise the preliminary construction schedule as required, and resubmit to the Engineer. The revised construction schedule shall be revised and/or accepted or rejected by the Engineer within 14 calendar days after receipt. The schedule, when accepted by the Engineer, shall constitute the Initial Construction Schedule until later revised schedules are submitted due to delays beyond the control and without the fault or negligence of the Contractor.

3. Acceptance: When the Initial Construction Schedule has been accepted, the Contractor shall submit to the Engineer the accepted digital/electronic schedule.

4. Additional Construction Schedules: The CONTRACTOR, if requested by the ENGINEER, shall provide a Revised Construction Schedule if, at any time, the ENGINEER considers the completion date to be in jeopardy because of any portion of the WORK falling behind schedule. The Revised Construction Schedule shall show how the CONTRACTOR intends to accomplish the WORK to meet the completion date. The form and method employed by the CONTRACTOR shall be the same as for the Initial Construction Schedule.

5. Construction Schedule Revisions: The CONTRACTOR shall modify any portions of the construction schedule that becomes infeasible because of portions of the WORK falling behind schedule, or for any other valid reason. Any portion of the WORK that cannot be completed by its originally-scheduled completion date shall be deemed to be behind schedule.

## C. Shop Drawings

1. Wherever called for in the Terms and Conditions, Contract Documents, or where required by the District, the Contractor shall furnish to the District for review, the digital/electronic files of the shop drawing submittals. The term "Shop Drawings" as used herein shall be understood to include detail design calculations, shop drawings, fabrication, and installation drawings, erection drawings, list, graphs, catalog sheets, data sheets, and similar items. Whenever the Contractor is required to submit design calculations as part of a submittal, such calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in the state wherein the project is to be built, unless otherwise directed.

2. If the submittal is returned to the Contractor marked "NO EXCEPTIONS TAKEN," formal revision and resubmission of said submittal will not be required.

3. If the submittal is returned to the Contractor marked "MAKE CORRECTIONS NOTED," formal revision and resubmission of said submittal will not be required.

4. If the submittal is returned to the Contractor marked "AMEND-RESUBMIT," the Contractor shall revise said submittal and shall resubmit the digital/electronic file of said revised submittal to the District.

5. If the submittal is returned to the Contractor marked "REJECTED-RESUBMIT," the Contractor shall revise said submittal and shall resubmit the digital/electronic file of said revised submittal to the District.

6. Fabrication of an item shall commence only after the District has reviewed the pertinent submittals and returned digital/electronic copies to the Contractor marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED." Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis for changes to the contract requirements.

7. All Contractor shop drawings submittals shall be carefully reviewed by an authorized representative of the Contractor, prior to submission to the District. Each submittal shall be dated, signed, and certified by the Contractor, as being correct and in strict conformance with the Contract Documents. In the case of shop drawings, each sheet shall be so dated, signed, and certified. No consideration for review by the District of any Contractor submittals will be made for any items which have not been so certified by the Contractor. All non-certified submittals will be returned to the Contractor without action taken by the District, and any delays caused thereby shall be the total responsibility of the Contractor.

8. The District's review of Contractor shop drawings submittals shall not relieve the Contractor of the entire responsibility for the correctness of details and dimensions. The Contractor shall assume all responsibility and risk for any misfits due to any errors in Contractor submittals. The Contractor shall be responsible for the dimensions and the design of adequate connections and details.

## D. Proposed Substitutes Or "Equal" Item Submittal

1. Whenever materials or equipment are specified or described in the contract documents by using the name of a proprietary item or the name of a particular Supplier, the naming of the item is intended to establish the type, function, and quality required. If the name is followed by the words "or equal" indicating that a substitution is permitted, materials or equipment of other Suppliers may be accepted by the Engineer if sufficient information is submitted by the Contractor to allow the Engineer to determine that the material or equipment proposed is equivalent or equal to that named, subject to the following requirements.

    a. The burden of proof as to the type, function, and quality of any such substitute material or equipment shall be upon the Contractor.

    b. The Engineer will be the sole judge as to the type, function, and quality of any such substitute material or equipment and the Engineer's decision shall be final.

    c. The Engineer may require the Contractor to furnish at the Contractor's expense additional data about the proposed substitute.

    d. The District may require the Contractor to furnish at the Contractor's expense a special performance guarantee or other surety with respect to any substitute.

    e. Acceptance by the Engineer of a substitute item proposed by the Contractor shall not relieve the Contractor of any responsibility for full compliance with the Contract Documents and for adequacy of the substitute item.

f. The Contractor shall be responsible for resultant changes and all additional costs which the accepted substitution requires in the Contractor's work, the work of its subcontractors and of other contractors, and shall effect such changes without cost to the District.

2. The procedure for review by the Engineer will include the following:

   a. If the Contractor wishes to furnish or use a substitute item of material or equipment, the Contractor shall make written application to the Engineer on the "Substitutions Request Form" for acceptance thereof.

   b. Unless otherwise provided by law or authorized in writing by the Engineer the "Substitution Request Form(s)" shall be submitted within the 35 day period after award of the Contract.

   c. Wherever a proposed substitute material or equivalent has not been submitted within said 35 day period, or wherever the submission of a proposed substitute material or equipment has been judged to be unacceptable by the Engineer, the Contractor shall provide the material or equipment named in the Contract Documents.

   d. The Contractor shall certify that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar and of equal substance to that specified, and be suited to the same use as that specified.

   e. The Engineer will be allowed a reasonable time within which to evaluate each proposed substitute.

   f. As applicable, no shop drawing submittals will be made for a substitute item nor will any substitute item be ordered, installed, or utilized without the Engineer's prior written acceptance of the Contractor's "Substitution Request Form" which will be evidenced by a Change Order.

3. The Contractor's application using the "Substitution Request Forms" shall contain the following statements and/or information which shall be considered by the Engineer in evaluating the proposed substitution:

   a. The evaluation and acceptance of the proposed substitute will not prejudice the Contractor's achievement of substantial completion on time.

   b. Whether or not acceptance of the substitute for use in the Work will require a change in any of the Contract Documents to adopt the design to the proposed substitute.

c. Whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty.

d. All variations of the proposed substitute for that specified will be identified.

e. Available maintenance, repair, and replacement service will be indicated.

f. Itemized estimate of all costs that will result directly or indirectly from acceptance of such substitute, including District time to review if excessive as determined by the Engineering Manager, cost of redesign and claims or other contractors affected by the resulting change.

## E. Samples Submittal

1. Whenever in the Specifications samples are required, the Contractor shall submit not less than 3 samples of each item or material to the Engineer.

2. Samples, as required herein, shall be submitted for acceptance a minimum of 21 days prior to ordering such material for delivery to the jobsite, and shall be submitted in any orderly sequence so that dependent materials or equipment can be assembled and reviewed without causing delays in the Work.

3. All samples shall be individually and indelibly labeled or tagged, indicating thereon all specified physical characteristics and Manufacturer's name of identification and submitted to the Engineer for acceptance. Upon receiving acceptance of the Engineer, one set of the samples will be stamped and dated by the Engineer and returned to the Contractor, and one set of samples will be retained by the Engineer, and one set of samples shall remain at the job site until completion of the Work.

4. Unless indicated otherwise, all colors and textures of specified items presented in sample submittals shall be from the manufacturer's standard colors and standard materials, products, or equipment lines.

## F. Technical Manual Submittal

1. The Contractor shall furnish to the Engineer one (1) set of technical manuals and in an electronic format with searchable PDF links. Each set shall consist of one or more volumes, each of which shall be bound in a standard size, 3-ring, loose-leaf, vinyl plastic hard cover binder suitable for bookshelf storage. Binder ring size shall not exceed 2.5 inches. A table of contents shall be provided which indicates all equipment in the technical manuals and in an electronic format with searchable PDF links.

2. Using the outline provided in the Equipment Maintenance Summary Sheet (copy of which may be obtained from the Engineer), the Contractor shall include in the

technical manuals for each item of mechanical, electrical, and instrumentation equipment the following:

a. Complete operating instructions, including location of controls, special tools or other equipment required, related instrumentation, and other equipment needed for operation.

b. Lubrication schedules, including the lubricant SAE grade and type, temperature range of lubricants, and including frequency of required lubrication.

c. Preventative maintenance procedures and schedules.

d. Spare Parts lists, by generic title and identification number, complete, with exploded views of each assembly.

e. Replacement Parts lists, by generic title and identification number, complete, with exploded views of each assembly.

f. Disassembly and reassembly instructions.

g. Name and location of nearest supplier and spare and replacement parts warehouse.

h. Recommended troubleshooting and start up procedures.

i. Reproducible prints of the record drawings, including diagrams and schematics, as required under the electrical and instrumentation portions of these specifications.

j. Tabulation of proper settings for all pressure relief valves, (low/high) pressure switches and other related equipment protection devices.

k. Detailed test procedures to determine performance efficiency of equipment.
l. List of all electrical relay settings including alarm and contact settings.

3. All technical manuals shall be submitted in final form to the Engineer not later than the 75 percent of construction completion date. All discrepancies found by the Engineer in the technical manuals shall be corrected by the Contractor within 30 days from the date of written notification by the Engineer.

## G. Spare and Replacement Parts Lists Submittal

The Contractor shall furnish to the Engineer one (1) set of spare and replacement parts lists of information for all mechanical, electrical, and instrumentation equipment. The spare and replacement parts lists shall include the current list price of each part. The

spare and replacement parts lists shall be limited to those spare and replacement parts which each manufacturer recommends be maintained by the District in inventory at the plant site. Each manufacturer or supplier shall indicate the name, address, and telephone number of its nearest outlet of spare and replacement parts to facilitate the District in ordering. The Contractor shall cross-reference all spare and replacement parts lists to the equipment numbers designed in the Contract Documents. The spare and replacement parts lists shall be bound in standard size, 3-ring, loose-leaf, vinyl plastic hard cover binders suitable for bookshelf storage. Binder ring size shall not exceed 2.5 inches and in an electronic format with searchable PDF links.

## H. As-Built Submittals

1. The Contractor shall keep and maintain, at the job site, one, as-built of Drawings. On these, it shall mark all project conditions, locations, configurations, and any other changes or deviations which may vary from the details represented on the original Contract Drawings, including buried or concealed construction and utility features which are revealed during the course of construction. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the locations indicated, or which were not indicated on the Contract Drawings. Said record drawings shall be supplemented by any detailed sketches as necessary or directed to indicate, fully, the Work as actually constructed. These master As-built of the Contractor's representation of as-built conditions, including all revisions made necessary by addenda and change orders shall be maintained up to date during the progress of the Work.

2. In the case of those drawings which depict the detail requirement for equipment to be assembled and wired in the factory, such as motor control centers and the like, as-built shall be updated by indicating those portions which are superseded by change order drawings or final shop drawings, and by including appropriate reference information describing the change orders by number and the shop drawings by manufacturer, drawing, and revision numbers.

3. As-built shall be accessible to the Engineer and/or Inspector at all times during the construction period and shall be delivered to the Engineer upon completion of the Work. Both a hard copy and digital/electronic copy of the as-built shall be provided.

4. Upon substantial completion of the Work and prior to final acceptance, the Contractor shall complete and deliver a complete set of as-built to the Engineer for transmittal to the District, conforming to the construction records of the Contractor. Both a hard copy and digital/electronic copy of the as-built shall be provided. This set of drawings shall consist of corrected drawings showing the reported location of the Work. The information submitted by the Contractor and incorporated by the Engineer into the Record Drawings will be assumed to be reliable, and the Engineer will not be responsible for the accuracy of such

information, nor for any errors or omissions which may appear on the Record Drawings as a result.

## I. Sheeting, Shoring, Bracing, Or Sloping Of Trenches Plan Submittal

1. Prior to commencement of any excavation, the Contractor shall submit to the District a detailed plan showing the design of sheeting, shoring, bracing, sloping, or equivalent method. The District shall only acknowledge receipt of the detailed plan.

2. In accordance with California Code of Regulations, Title 8, Section 341 (Permit Requirements), the Contractor shall obtain a permit from the State of California Division of Industrial Safety prior to any trench excavation. A copy of said permit shall be kept at the job site and available to the District Representative upon request.

## J. Storm Water Pollution Prevention Plan (SWPPP) Submittal

When so specified in the General Provisions, Special Provisions, Detail Specifications or Plans, or if so required by the California State Water Resources Control Board, the Contractor shall prepare and submit a storm water pollution prevention plan. The SWPPP shall conform to the requirements specified in the General Provisions, Special Provisions, Detail Specifications or Plans and those of the California State Water Resources Control Board. The Notice of Intent will be filed by the District.

# PART 2 – PRODUCTS

Not Used.

# PART 3 – EXECUTION

Not Used.

**END OF SECTION**

# SECTION 02100

# CLEARING AND PREPARATION

## PART 1 - GENERAL

### A. Description

This section includes clearing, grubbing, preparation and Notification of District prior to rough grading.

### B. Related Work Specified Elsewhere

Earthwork and Grading: 02201

### C. Submittals

Submit a schedule of work and a detailed description of removal and disposal techniques.

## PART 2 - MATERIALS (NOT APPLICABLE)

## PART 3 - EXECUTION

### A. Meeting

A field meeting shall be held with the District's Representative to discuss limits and disposal of material at least 48 hours prior to the start of clearing and grubbing operations.

### B. Limits

Clearing and preparation operations shall be confined to the limits shown on the construction plans. Only specified access roads shall be used for operation.

### C. Disposal

All brush, stumps, roots, vegetation and debris shall be removed from the site and disposed of in a manner acceptable to agencies having jurisdiction over the work, the soils consultant, and the District.

## D. Stockpiling

Top soil shall be stockpiled at the location shown on the plans, or as directed by the District's Representative. Stockpile shall be placed, graded, and shaped to promote proper drainage of stockpile area.

## E. Permits

All permit requirements shall be complied with during the course of the work, both for transportation and disposal of materials.

**END OF SECTION**

# SECTION 02201

# EARTHWORK AND GRADING

## PART 1 – GENERAL

### A. Description

This section presents general procedures and requirements for grading and earthwork as shown on the approved grading plans, including preparation of areas to be filled, placement of fill, installation of subdrains, and excavations.

### B. Related Work Specified Elsewhere

Clearing and Preparation: 02100

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300 and the following:

2. Material samples and grain size analyses shall be submitted for any imported fill material used.

3. Compliance with all applicable shall be supplied for any subdrain pipe installed.

### D. Measurement and Payment

Payment for the work in this section shall be in accordance with the General Provisions and the following.

Payment for any additional cut yardage or removal/ recompaction yardage shall be at the unit-price bid amount for these items. Additional cut yardage or removal/ recompaction yardage may be required when field conditions dictate modifications to the original scope of the construction plans and when required by the District Representative. Measurement of additional yardage shall be made by the District's Representative after consultation with the soils consultant, Engineer, and Contractor.

### E. Permits

The Contractor shall comply with all requirements of the California State Water Resources Control Board (SWRCB) for the discharges of storm water associated with construction activities, including all required permits and development and

implementation of a Storm Water Pollution Prevention Plan (SWPPP), where required.

## PART 2 - MATERIALS

### A. Fill Material

1. General: Material to be placed as fill shall be free of organic matter and other deleterious substances, and shall be approved by the District's Representative. Expansive soils, or soils of poor gradation or strength characteristics shall either be removed from the site, and disposed of in accordance with all local regulations, placed in areas designated by the District's Representative, or mixed with other soils to serve as satisfactory fill or soil material.

2. Oversize Material: Oversize material defined as rock or other irreducible material with a maximum dimension greater than 12 inches, shall not be buried or placed in fills, unless the location, materials, and disposal methods are specifically approved by the District's Representative. Oversize disposal operations shall be such that nesting of oversize material does not occur, and such that the oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 feet vertically of finish grade or within the range of future utilities or underground construction, unless specifically approved by the District's Representative.

3. Imported Fill Material: If importing of fill material is required for grading, the import material shall meet the requirements above.

### B. Subdrain Pipe

Subdrain pipe shall be ASTM D2751, SDR 23.5 or ASTM D1527, Schedule 40 Acrylonitrile Butadiene Styrene (ABS), ASTM D3034 SDR 23.5 or ASTM D1785, Schedule 40 Polyvinyl Chloride Plastic (PVC) pipe, or for contracts between District and Contractor, approved equal.

### C. Filter Material

Filter material shall be Class 2 permeable material per State of California Department of Transportation Standard Specifications. Class 2 grading shall be as follows:

| Sieve Size | Percent Passing |
|---|---|
| 1” | 100 |
| 3/4” | 90-100 |
| 3/8” | 40-100 |
| No. 4 | 25-40 |
| No. 8 | 18-33 |
| No. 30 | 5-15 |
| No. 50 | 0-7 |
| No. 200 | 0-3 |

**D. Filter Fabric Material**

Unless specified otherwise, filter fabric shall be non-woven polyester material conforming to the following requirements:

| Property | ASTM Method | Property Value |
|---|---|---|
| Weight, oz. per sq. yd., min. | D 1910 | 4 |
| Elongation, %, min. | D 4632 | 30 |
| Grab Tensile Strength, lbs., min. | D 4632 | 90 |
| Permittivity, $Sec^{-1}$, min. | D 4491 | 5 |
| Toughness, lbs., min. (Percent Elongation x Grab Tensile Strength | -- | 4000 |

## PART 3 - EXECUTION

**A. Earthwork Observation Testing**

1. Access: Adequate access shall be provided at all times to allow the District's Representative to make observations and conduct tests to verify that the work complies with the requirements of the specifications. The District's Representative shall be given assistance as necessary for performing test, and shall be kept apprised of work schedules.

2. Methods: Adequate equipment and methods shall be employed to accomplish the work in accordance with applicable grading codes or agency ordinances, these specifications and the approved grading plans. If, in the opinion of the District's Representative, unsatisfactory conditions, such as questionable soil, poor moisture condition, inadequate compaction, adverse weather, etc., have resulted in a quality of work less than required in these specifications, the District may reject the work and recommend that construction be stopped until the conditions are rectified.

3. Compaction Testing: Maximum dry density test used to determine the degree of compaction will be performed in accordance with the American Society for Testing and Materials ASTM Test Method D1557.

## B. Preparation of Areas to be Filled

1. Clearing and Grubbing: All brush, vegetation and debris shall be removed or piled and otherwise disposed of per Section 02100, Clearing and Preparation.

2. Processing: The existing ground which is determined to be satisfactory for support of fill shall be scarified to a minimum depth of 6 inches. Existing ground which is not satisfactory shall be overexcavated as specified in the following subsection. Scarification shall continue until the soils are broken down and free of large clay lumps or clods and until the working surface is reasonably uniform and free of uneven features which would inhibit uniform compaction.

3. Overexcavation: Soft, dry, spongy, highly fractured or otherwise unsuitable ground, extending to such a depth that surface processing cannot adequately improve the condition, shall be overexcavated down to firm ground, as directed by the District's Representative.

4. Moisture Conditioning: Overexcavated and processed soils conforming to "Fill Material" specified herein shall be watered, dried-back, blended, and/or mixed, as required to attain a uniform moisture content near the optimum moisture content prior to placement and compaction.

5. Recompaction: Overexcavated and processed soils which have been properly mixed and moisture-conditioned shall be recompacted to a minimum of 90 percent of maximum dry density. Within City of Yorba Linda street zones, soils shall be recompacted to a minimum of 95 percent of maximum dry density, or as directed by the City’s permit requirements.

6. Benching: Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. The lowest bench shall be a minimum of 15 feet wide, shall be at least 2 feet deep, shall expose firm material, and shall be approved by the District Representative. Other benches shall be excavated in firm material for a minimum width of 4 feet. Ground sloping flatter than 5:1 shall be benched or otherwise overexcavated when considered necessary by the District's Representative.

7. Approval: All areas to receive fill, including processed areas, removal areas and toe-of-fill benches shall be approved by the District's Representative prior to fill placement.

## C. Fill Placement and Compaction

1. Fill Lifts: Approved fill material shall be placed in areas prepared to receive fill in near-horizontal layers not exceeding 6 inches in compacted thickness. The District may approve thicker lifts if testing indicates the grading procedures are such that adequate compaction is being achieved with lifts of greater thickness. Each layer shall be spread evenly and shall be thoroughly mixed during spreading to attain uniformity of material and moisture in each layer.

2. Fill Moisture: Fill layers having a moisture content less than optimum shall be watered and mixed. Fill layers having a moisture content greater than optimum shall be aerated by scarification or shall be blended with drier material. Moisture-conditioning and mixing of fill layers shall continue until the fill material is plus or minus two percent of the optimum moisture content.

3. Compaction of Fill: After each layer has been evenly spread, moisture-conditioned, and mixed it shall be uniformly compacted to not less than 90 percent of maximum dry density. Compaction equipment shall be adequately sized and shall be either specifically designed for soil compaction or of proven reliability, to efficiently achieve the specified degree of compaction.

4. Fill Slopes: Fill slopes shall be overfilled and compacted, then blade cut to a firm surface. Compacting of fill slopes shall be accomplished, in addition to normal compacting procedures, by back- rolling of slopes with sheepsfoot rollers at frequent increments of 2 to 3 feet in fill elevation gain, or by other methods producing satisfactory results. At the completion of grading, the relative compaction of the slope out to the slope face shall be at least 90 percent of maximum dry density.

5. Compaction Testing: Field test to check the fill moisture and degree of compaction shall be performed by the District's Representative. The location and frequency of tests shall be at the District's Representative discretion. In general, the tests will be taken at an interval not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of embankment. In addition, on slope faces, at least one test shall be taken for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope.

## D. Subdrain Installation

Subdrains shall consist of drain pipe, compacted pipe trench backfill aggregate, and filter fabric material to prevent migration of soil fines into the subdrain system. Subdrain systems shall be installed in approved ground to conform to the size and alignment, and to the details as may be shown in the Contract Documents. The

subdrain location or materials shall not be changed or modified without the approval of the District's Representative. All subdrains shall be surveyed for line and grade after installation and sufficient time shall be allowed for the surveys, prior to commencement of filling over the subdrains.

## E. Excavation

Excavations and cut slopes will be examined during grading. If directed by the District's Representative, further excavation or overexcavation and refilling of cut areas shall be performed, and/or remedial grading of cut sloped shall be performed. Where fill-over-cut slopes are to be graded, unless otherwise approved, the cut portion of the slope shall be made and approved by the District's Representative prior to placement of materials for construction of the fill portion of the slope.

## F. Grading Code

All work shall be in accordance with the grading code requirements of the agencies having jurisdiction over the work. A copy of grading codes and manuals shall be retained on the job site while work is in progress. When referenced on the plans, a copy of the County of Orange, Environmental Management Agency Standard Plans shall also be retained on the site.

## G. Maintenance

1. Protection of Graded Areas: Newly graded areas shall be protected from traffic and erosion. Settled, eroded, and rutted graded areas shall be repaired and re-established to specified tolerances.

2. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, these areas shall be scarified, re-shaped, and compacted to required density prior to further construction.

3. Settling: Where settling is measurable or observable at excavated areas during the project or warranty period, the surface (pavement, lawn or other finish), shall be removed, backfill material added and compacted, and surface treatment replaced. The appearance, quality, and condition of surface or finish shall be restored to match adjacent work.

**END OF SECTION**

# SECTION 02220

# STRUCTURE EARTHWORK

## PART 1 - GENERAL

### A. Description

This section describes excavation, backfilling, materials, testing, and shoring for underground structures including control valve vaults, wet wells, dry well vaults, meter vaults, valve vaults, pump vaults, and pressure reducing vault stations.

### B. Related Work Specified Elsewhere

1. Trenching, Backfilling, and Compacting: 02223.

2. Pavement Removal and Replacement: 02578.

3. Concrete Formwork: 03100.

4. Pre-Cast Concrete Vault: 03462

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300.

2. Submit drawings of excavation and shoring, sheeting or bracing for worker protection.

3. Submit digital/electronic copy of a report from a testing laboratory verifying that gravel base and structural backfill conforms to the specified gradations or characteristics.

4. Test reports on borrow material.

5. Other tests and material reports as required by the Soils Engineer.

### D. Protection of Existing Utilities and Facilities

1. General: The Contractor shall be responsible for the care and protection of all existing sewer pipelines, water pipelines, gas mains, storm drains, culverts, or other facilities and structures that may be encountered in or near the area of work.

2. Notification: It shall be the duty of the Contractor to notify each agency of jurisdiction and make arrangements for locating each agency's facilities prior to beginning construction. The Contractor shall notify Underground Service Alert (Dig Alert) at least two working days prior to construction at 1-800-227-2600.

3. Damage: In the event of damage to any existing facilities during the progress of the work due to the failure of the Contractor to exercise the proper precautions, the Contractor shall be responsible for the cost of all repairs and protection to said facilities. The Contractor's work may be stopped until repair operations are complete.

## E. Protection of Landscaping

The Contractor shall be responsible for the protection of all the trees, shrubs, fences, and other landscape items adjacent to or within the work area, unless directed otherwise on the plans. In the event of damage to landscape items, the Contractor shall replace the damaged items in a manner satisfactory to the District Representative.

# PART 2 - MATERIALS

## A. Definition of Zones

1. Pavement and Street Zones: Pavement and street zones shall be as defined in Section 02223: Trenching, Backfilling and Compacting.

2. Upper Backfill Zone: The upper backfill zone is defined as the backfill to the full width of the excavation from the top of the structure to the bottom of the street zone in paved areas or to the finished surface in unpaved areas.

3. Structural Backfill Zone: The structural backfill zone is defined as backfill from the top of the structure to the bottom of the excavation, extending the full width of the excavation.

## B. Native Earth Backfill-Upper Backfill Zone

Native earth backfill shall be excavated fine grained non-organic materials free from peat, roots, debris, and rocks larger than 3 inches, and which can be compacted to the specified relative compaction.

## C. Structural Backfill - Structural Backfill Zone

Structural backfill materials shall consist of hard, durable, and clean sand, gravel, or crushed stone which is free of organic material, clay balls, and other deleterious substances, and shall have the following gradation:

| Sieve Size | Percent Passing by Weight |
|---|---|
| 2” | 100 |
| 1-1/2” | 95-100 |
| 3/4” | 50-100 |
| 3/8” | 15-55 |
| No. 4 | 0-25 |
| No. 8 | 0-5 |
| No. 200 | 0-3 |

## D. Crushed Rock

3/4" Crushed or natural rock with the following gradation shall be provided under the structure.

| Sieve Size | Percent Passing by Weight |
|---|---|
| 1” | 100 |
| 3/4” | 90-100 |
| 1/2” | 30-60 |
| 3/8” | 0-20 |
| No. 4 | 0-5 |

## E. Water for Compaction

Water used to assist in compaction shall conform to Section 02223, Trenching, Backfilling, and Compacting.

# PART 3 - EXECUTION

## A. Testing for Compaction

Testing for compaction shall conform to Section 02223, Trenching, Backfilling, and Compacting.

## B. Compaction Requirements

1. Backfill in Street Zone: 95% relative compaction.
2. Upper Backfill Zone: 90% relative compaction.

3. Structural Backfill Zone: 90% relative compaction.

4. Crushed Rock: 80% relative density.

## C. Dewatering

1. General: Dewatering operations shall continuously remove and dispose of all water entering the excavation during construction of the structure and all backfill operations. Water shall be disposed of in a manner to prevent damage to adjacent property and pipe trenches in conformance with all local regulations. Water shall not be allowed to rise in the excavation until backfilling around and above the structure is completed.

2. Notification: The District shall be notified 48 hours prior to commencement of dewatering operations. Methods employed shall be in conformance with the District's existing NPDES permit for contracts between District and Contractor. A copy of the NPDES permit is generally included in the appendix of the Project Manual with the project specifications.

## D. Structure Excavation

1. Removal of Material: Structure excavation shall include the removal of all material necessary for the construction of underground structures and foundations.

2. Clearance: Unless noted otherwise on the plans, the sides of excavations for structures shall be sufficient to leave at least a 2-foot clearance, as measured from the extreme outside of formwork or the structure. Excavation side slopes shall be as specified in Subsection E.

3. Overdepth Excavations: Overdepth excavations shall be corrected by backfilling with crushed rock or concrete, as directed by the District's Representative. No native earth backfill will be permitted to correct overdepth excavation beneath structures.

4. Surplus Material: Surplus material shall be disposed of in accordance with Section 02223, Trenching, Backfilling, and Compacting.

## E. Support for Excavations for Structures

1. Safety: A safe working area shall be provided for workers. The services of a Registered Civil Engineer shall be obtained to design sheeting, shoring and bracing, or side slopes. The requirements of CAL/OSHA and of these specifications shall be used as minimum design criteria. Sufficient geotechnical data shall be obtained to provide safe design.

2. Side Slopes: Minimum side slope shall be per CAL/OSHA but not steeper than:

   a. Clayey soil up to 12-foot depth: ¾ horizontal to 1 vertical (¾:1).

   b. Clayey soil more than 12-foot depth: vary from ¾:1 for 12-foot depth to 3:1 for 20-foot depth.

   c. Gravelly soil: 2:1.

   d. Flatten above slopes if groundwater is present.

3. Traffic Safety: Methods of support or side slopes shall be selected to provide sufficient clearance for public traffic safety and convenience.

4. Design Loads: The characteristics of the soil exposed in the excavation, the groundwater conditions, traffic, and other surcharge loads shall be considered when selecting lateral pressures to be used for design of soil supporting systems.

5. Design Criteria: The following as minimum design criteria for allowable lateral passive soil pressure expressed in pounds per square foot (psf) shall be used to calculate depth of penetration of isolated soldier piles or solid sheet piles. Where needed for safety, these values shall be increased.

| | **Predominant Soil Type** | |
|---|---|---|
| | **Clayey** | **Granular** |
| Isolated Soldier | 200 Z + 1,870 | 467 Z |
| Solid Sheet | 67Z + 633 | 300 Z |

   Where Z = depth in feet below bottom of excavation.

6. Verification of Soil Types: Prior to design and submittal of support system, verification of the type of soil below the bottom of the excavation shall be made.

## F. Backfill Against Walls and Over Roof Slabs

1. Precautions:

a. Backfill over structure shall be placed in a manner so as to not damage the roof membrane and protective cover.

b. Backfill shall not be placed against walls or above buried roof slabs until the concrete has obtained a comprehensive strength equal to the specified 28-day compressive strength. Where backfill is to be placed on both sides of the wall, the backfill shall be placed uniformly on both sides. Where backfill is to be placed around a structure, the backfill shall be placed at a uniform rate around the structure.

c. Backfill shall not be placed against the walls of structures that are laterally restrained or supported by suspended slabs or slabs on grade until the slab is poured and the concrete has reached the specified compressive strength.

d. When backfill is to be placed before 7-day concrete strength tests have been conducted on concrete arches for VCP sewers or thrust blocks, the concrete shall have achieved 50 percent of the specified minimum 28-day strength. An additional test cylinder shall be made for this test.

2. Equipment: Equipment for placing and compacting backfill over structures shall not exceed 15 tons total weight and a maximum wheel load of 10,000 pounds. Equipment weighing more than 10,000 pounds shall not be used closer to walls and structures than a horizontal distance equal to the depth of fill at the time.

## G. Compaction

1. Compaction for Zones: Compaction shall be controlled to the percentage of density specified for each zone.

2. Moisture Control: Moisture shall be controlled as follows:

a. Where subgrade or soil material layers must be moisture conditioned before compaction, water shall be uniformly applied to the subgrade surface or soil layer material in order to prevent free water from appearing on the surface during or subsequent to compaction operations. The moisture content of the compacted soil shall be within 3 percentage points of the optimum.

b. Soil material that is too wet to permit compaction to specify density shall be removed and replaced or scarified and air dried.

c. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread within an approved area and allowed to dry. Drying may be assisted by discing, harrowing or pulverizing, until moisture content is reduced to satisfactory value.

d. Backfill or fill material shall not be placed on surfaces that are muddy, frozen, or contain frost or ice.

3. Requirements Prior to Backfilling: Excavations shall be backfilled as work permits, but not until completion of the following:

   a. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.

   b. Inspection, testing, approval, and recording locations of underground utilities.

   c. Removal of concrete formwork per Section 03100.

   d. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place, if required.

   e. Removal of trash and debris.

   f. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

4. Backfill Layers: Backfill and fill materials shall be placed in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

5. Jetting: Unless specified otherwise, jetting techniques shall not be employed to densify granular fill materials.

6. Uniform Backfill Lifts: Backfill and fill materials shall be placed evenly adjacent to structures, to required finish elevations. Care shall be taken to prevent wedging action of backfill against structures by carrying material uniformly around structure to approximately same elevation in each lift.

**END OF SECTION**

# SECTION 02223

# TRENCHING, BACKFILLING, AND COMPACTING

## PART 1 - GENERAL

### A. Description

This section describes materials, testing, and performance of trench excavation, backfilling, and compacting.

### B. Related Work Specified Elsewhere

1. Pavement Removal and Replacement: 02578

2. Concrete: 03300

3. Hydrostatic Testing of Pressure Pipelines: 15042

4. Cathodic Protection and Joint Bonding: 16640

### C. Submittals

1. Submit shop drawing in accordance with Section 01300.

2. Shop drawings in accordance with Section 01300 shall be submitted showing excavation and shoring, bracing, or sloping for worker protection.

3. Digital/electronic copy of a report from a testing laboratory shall be submitted verifying that backfill material conforms to the specified gradations or characteristics for pea gravel, granular material, imported sand, rock refill for foundation stabilization, and water.

4. Copy of compaction report from geotechnical engineer.

### D. Measurement and Payment

1. Payment for the work in this section shall be in accordance with the General Provisions and the following:

   Payment for foundation stabilization shall be made in accordance with the unit-price bid amount for any quantity of refill material from 0 to 1,000 cubic yards, based on the trench details shown on the plans. These items have been included in the bid form for work that may possibly be required to complete the project, but which cannot be reasonably predicted, and shall be the basis of payment for refill material for foundation stabilization if authorized in writing

by the District. The unit price, including soil testing, shall be for any quantity installed, complete in place, including all additional earthwork, disposal of all excess or waste material, and placing of the refill material. The District's Representative shall be the sole judge as to the necessity, the amount, and depth that may be required in any given situation. No additional payment shall be made for foundation stabilization that is not authorized by the District.

## E. Protection of Existing Utilities and Facilities

1. General: The Contractor shall be responsible for the care and protection of all existing sewer pipelines, water pipelines, gas mains, storm drains, culverts, or other facilities and structures that may be encountered in or near the area of work.

2. Notification: It shall be the duty of the Contractor to notify each agency of jurisdiction and make arrangements for locating each agency's facilities prior to beginning construction. The Contractor shall notify Underground Services Alert (Dig Alert) at least two working days prior to construction at 1-800-227-2600.

3. Damage: In the event of damage to any existing facilities during the progress of the work due to the failure of the Contractor to exercise the proper precautions, the Contractor shall be responsible for the cost of all repairs and protection to said facilities. The Contractor's work may be stopped until repair operations are complete.

   In the event that the Contractor hits and damages an unmarked facility, resulting in a change order, the Contractor shall be responsible for collecting reimbursement from the agency that failed to properly mark their facility. The District shall not be responsible or assist in the reimbursement process.

## F. Protection of Landscaping

1. General: The Contractor shall be responsible for the protection of all the trees, shrubs, fences, and other landscape items adjacent to or within the work area, unless directed otherwise on the plans. In the event of damage to landscape items, the Contractor shall replace the damaged items in a manner satisfactory to the District Representative.

2. Restoration: After the completion of work in planted or improved areas within public or private easements, the Contractor shall restore such areas to original condition or as otherwise specified by the Engineering Manager.

## PART 2 - MATERIALS

### A. Definition of Zones

1. Pavement Zone: The pavement zone shall include the asphaltic concrete and aggregate base pavement section placed over the street zone. This zone is often referred to as the "structural section" of the street or highway.

2. Trench Zone: The trench zone shall include the portion of the trench from the top of the pipe zone to the bottom of the pavement zone in paved areas or to the existing surface in unpaved areas.

3. Street Zone: The street zone is a portion of the trench zone to be defined by the jurisdictional agency, and is immediately below the pavement zone in paved areas or areas to be paved.

4. Pipe Zone: The pipe zone shall include the full width of trench from the bottom of the pipe or conduit to a horizontal level 12-inches above the top of the pipe. Where multiple pipes or conduits are placed in the same trench, the pipe zone shall extend from the bottom of the lowest pipes to a horizontal level above the top of the highest or topmost pipe.

5. Pipe Base: The pipe base shall be defined as a 6-inch layer of material immediately below the pipe zone and extending over the full trench width.

### B. Trench Zone

1. Native material shall be excavated, hauled away, and properly disposed of.

   Subject to approval by the District and local jurisdiction, native material obtained from project excavations may be used as backfill provided that the material is fine-grained and non-organic, free from peat, roots, debris, and rocks larger than 3-inches, and which can be compacted to the specified relative compaction. Must have soil inspection and report. See Part 3 – Execution of this section.

2. Trench zone backfill for all public and private streets shall consist of crushed aggregate base compacted to 95% relative compaction. 1½-sack slurry, poured and vibrated in place, may be used only if required by the local jurisdiction (for public streets only) or contract documents.

   Crushed miscellaneous base material may be substituted for crushed aggregate base material by special permission from the District and local jurisdiction. In such cases, material shall conform to the requirements of the Standard Specifications for Public Works Construction, Section 200-2.4. Must have soil inspection and report. See Part 3 – Execution of this section.

## C. Backfill--Pipe Zone and Pipe Base

1. Ductile iron pipe, welded steel pipe (CML&C), PVC pressure pipe, pretensioned concrete cylinder pipe, pre-stressed concrete cylinder pipe, PVC-lined reinforced concrete pipe, and copper pipe: Unless otherwise specified or shown on the plans, the pipe base and pipe zone backfill material shall be imported sand as specified herein.

2. Sewer vitrified clay pipe: Unless otherwise specified or shown on the plans, pipe base and pipe zone backfill material shall be ¾-inch crushed rock as specified herein.

3. Sewer PVC pipe: Unless otherwise specified or shown on the plans, pipe base and pipe zone backfill material shall be ¾-inch crushed rock or imported sand as specified herein.

## D. Imported Sand--Pipe Zone and Pipe Base

Imported sand used in the pipe zone or for the pipe base shall have the following gradation:

| Sieve Size | Percent Passing by Weight |
|---|---|
| 3/8” | 100 |
| No. 4 | 75-100 |
| No. 30 | 12-50 |
| No. 100 | 5-20 |
| No. 200 | 0-15 |

Minimum sand equivalent shall be 30 per ASTM D 2419.

## E. Crushed Rock--Pipe Zone and Pipe Base

Crushed rock material shall conform to the Standard Specifications for Public Works Construction, Section 200-1.2 and shall meet the following gradation:

| Sieve Size | Designated Material Size | | | |
|---|---|---|---|---|
| | 1-1/2-inch | 1-Inch | 3/4-Inch | 3/8-Inch |
| | Percent Passing | Percent Passing | Percent Passing | Percent Passing |
| 2-inches | 100 | -- | -- | -- |
| 1-1/2-inches | 90-100 | 100 | -- | -- |
| 1-inch | 20-55 | 90-100 | 100 | -- |
| 3/4-inch | 0-15 | 30-60 | 90-100 | -- |
| 1/2-inch | -- | 0-20 | 30-60 | 100 |
| 3/8-inch | 0-5 | -- | 0-20 | 90-100 |
| No. 4 | -- | 0-5 | 0-5 | 30-60 |
| No. 8 | -- | -- | -- | 0-10 |

Crushed aggregate base materials used for pipe bedding shall be ¾-inch unless otherwise called for by the project plans and specifications or as directed by the District Representative.

Crushed miscellaneous base materials may be substituted for crushed aggregate base materials by special permission from the District. In such cases, materials shall conform to the requirements of the Standard Specifications for Public Works Construction, Section 200-2.4.

## F. Refill Material for Foundation Stabilization

Refill material below the pipe shall be either material conforming to the 1½-inch size requirement for gravel or crushed rock, or naturally occurring rock having the following gradation:

| Sieve Size | Percent Passing by Weight |
|---|---|
| 3” | 100 |
| 1-1/2” | 70-100 |
| 3/4” | 60-100 |
| No. 4 | 5-55 |
| No. 30 | 0-30 |
| No. 200 | 0-10 |

**G. Sand-Cement Slurry Refill Material for Foundation Stabilization in Pipe Base and Pipe Zone or Backfill for Street Zone and Trench Zone.**

Sand-Cement slurry shall consist of 1½ sacks of portland cement per cubic yard of sand and sufficient moisture for workability.

**H. Pea Gravel**

Pea gravel shall be defined as gravel, uniformly graded from coarse to fine with less than 10% passing a No. 200 sieve, less than 50% passing a No. 4 sieve, and having a maximum particle size of ¾-inch.

**I. Water for Compaction**

Water used in compaction shall have a maximum chloride concentration of 500 mg/l, a maximum sulfate concentration of 500 mg/l, and shall have a pH of 7.0 to 9.0. Water shall be free of acid, alkali, or organic materials injurious to the pipe coatings.

**J. Pavement Zone Materials**

Pavement zone materials shall be as specified in Section 02578, Pavement Removal and Replacement unless otherwise specified by a jurisdictional agency permit.

## PART 3 - EXECUTION

**A. Testing for Compaction**

1. Methods: The density of soil shall be determined in place by the sand cone method, ASTM D 1556, or by the nuclear method, ASTM D 2922 or D 3017.

2. Soil Moisture-Density Relationship: The laboratory moisture-density relations of soils shall be determined per ASTM D 1557.

3. Cohesionless Materials: The relative density of cohesionless materials shall be determined by ASTM D 4253 and D 4254.

4. Sampling: Backfill materials shall be sampled per ASTM D 75.

5. Relative Compaction: "Relative compaction" shall be expressed as the ratio, expressed as a percentage, of the in place dry density to the laboratory maximum dry density.

6. Compaction Compliance: Compaction shall be deemed to comply with the specifications when none of the tests falls below the specified relative compaction. When tests are conducted by the District, the Contractor shall

notify the District 24-hours in advance of when backfill lifts are ready for testing, and shall pay the costs of any retesting of work not conforming to the specifications.

## B. Compaction Requirements

Unless otherwise shown on the drawings or otherwise described in the specifications for the particular type of pipe installed, relative compaction in pipe trenches shall be as follows:

1. Pipe Base and Pipe Zone: Pipe base and pipe zone--90% relative compaction. Note 95% relative compaction requirement in specific areas shown on the plan and profile drawings.

2. Trench Zone - Not Beneath Paving: Backfill in trench zone not beneath paving: 95% relative compaction.

3. Trench Zone - Paved Areas: Backfill in trench zone in paved areas: 95% relative compaction.

4. Street Zone: Backfill in street zone in paved areas: 95% relative compaction, or as required by the jurisdictional agency.

5. Foundation Stabilization: Rock refill material for foundation stabilization: 90% relative density.

6. Overexcavation: Rock refill for overexcavation: 90% relative density.

7. Material Testing: All imported or native materials shall be tested before the start of compaction operations to determine the moisture density relationship for materials with cohesive components, and the maximum density for cohesionless materials. Variations in imported or native earth materials may require a number of base curves of the moisture-density relationship.

8. Testing Intervals: Unless noted otherwise, compaction tests shall be performed at random depths and at 200-foot intervals, and as directed by the District's Representative.

## C. Material Replacement

Trenching and backfilling material which does not meet the specifications shall be removed and replaced at no additional expense to the District.

## D. Sheeting, Shoring, and Bracing of Trenches

Trenches shall have sheeting, shoring, and bracing conforming to CAL/OSHA requirements and General Provisions.

## E. Sidewalk, Pavement, and Curb Removal

Bituminous and concrete pavements regardless of the thickness and curbs and sidewalks shall be cut prior to excavation of the trenches in accordance with Section 02578, Pavement Removal and Replacement. Pavement and concrete materials shall be removed from the site and shall not be used for trench backfill.

## F. Trench Width

Pipe Diameter 12-inches and Greater: Unless shown otherwise on the drawings, trench widths in the pipe zone shall be equal to the pipe outside diameter plus 12-inches minimum. Trench width shall be the same from trench bottom to top.

## G. Grade

Trenches shall be excavated to the lines and grades shown on the drawings with allowance for pipe thickness and for pipe base. If the trench is excavated below the required grade, the portion of the trench excavated below the grade shall be refilled with refill material at no additional cost to the District. The refill material shall be placed over the full width of trench in compacted layers not exceeding 6-inches deep to the required grade with allowance for the pipe base. Hard spots that would prevent a uniform thickness of pipe base shall be removed. Before laying pipe sections, the grade shall be checked with a straightedge and any irregularities corrected. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point.

## H. Pipe Base Thickness

Thickness of the pipe base shall be as shown on the drawings or as otherwise described in the specifications for the particular type of pipe installed, but in no cases shall the thickness be less than 6-inches.

## I. Dewatering

1. Means and Devices: Suitable means and devices shall be provided and maintained to continuously remove and dispose of all water entering the trench excavation during the time the trench is being prepared for the pipe laying, during the laying of the pipe, and until the backfill at the pipe zone has been completed. These provisions shall apply during the noon hour as well as overnight. Water shall be disposed of in a manner to prevent damage to adjacent property. Trench water shall not be drained through the pipeline

under construction. Groundwater shall not be allowed to rise around the pipe until jointing compound has firmly set.

2. Notification: The District shall be notified 48 hours prior to commencement of dewatering. Methods employed shall be in conformance with NPDES permit procured by the contractor.

## J. Storage of Excavated Material

During trench excavation, excavated material shall be stored only within the working area. Roadways or streets shall not be obstructed. The safe loading of trenches with excavated material shall conform to federal, state, and local codes.

## K. Length of Open Trench

The length of open trench shall be limited to 600 feet in advance of pipe laying or amount of pipe installed in one working day. Backfilling and temporary or first layer paving shall be completed so that not more than 500 feet of trench is open in the rear of pipe laying. Sidewalks, driveways and other traveled ways shall be backfilled or adequately bridged to provide safe access and egress at the completion of each day's work.

## L. Foundation Stabilization

After the required excavation has been completed, the District Representative shall inspect the exposed trench subgrade to determine the need for any additional excavation. It is the intent that additional excavation shall be conducted in all areas within the influence of the pipeline where unacceptable materials exist at the exposed subgrade. Overexcavation shall include the removal of all such unacceptable material that exists directly beneath the pipe base and to the depth required. The presence of unacceptable material may require excavating a wider trench. The width and depth of known areas to be overexcavated shall be shown on the drawings. The overexcavated portion of the trench shall be backfilled to the subgrade of the pipe base with refill material for foundation stabilization. Foundation stabilization material shall be placed over the full width of the excavation and compacted in layers not exceeding 6-inches in depth, to the required grade.

## M. Trench Backfilling and Compaction

1. General: Trench backfill shall conform to requirements of the detailed piping specification for the particular type of pipe and following.

2. Pipe Base: The specified thickness of pipe base material shall be placed over the full width of trench. The top of the pipe base shall be graded ahead of the pipe laying to provide firm, uniform support along the full length of pipe.

3. Bell Holes: Bell holes shall be excavated at each joint to permit proper assembly and inspection of the entire joint.

4. Pipe Zone: After the pipe has been bedded, pipe zone material shall be placed simultaneously on both sides of the pipe, keeping the level of backfill the same on each side. Material shall be carefully placed around the pipe so that the pipe barrel is completely supported and that no voids or uncompacted areas are left beneath the pipe. Particular care shall be taken in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling. Material placed within the pipe zone shall be compacted by hand tamping only, unless otherwise specified. Compaction by jetting shall be permitted only where required by the jurisdictional agency.

5. Trench Zone: Backfill material shall be carefully deposited onto the backfill previously placed in the pipe zone. Free fall of the material shall not be permitted until at least 2 feet of cover is provided over the top of the pipe. Sharp, heavy pieces of material shall not be dropped directly onto the pipe or the tamped material around the pipe.

6. Trench Backfill: Trench backfill shall be compacted to the specified relative compaction. Compaction shall be performed by using mechanical compaction or hand tamping equipment. Consolidation by jetting or flooding shall be permitted only where required by the jurisdictional agency. High impact hammer-type equipment shall not be used except where the pipe manufacturer warrants in writing that such use will not damage the pipe.

7. Equipment: Axle-driven or tractor-drawn compaction equipment shall not be used within 5 feet of walls and structures.

8. Street Zone Backfill: Street zone backfill shall be done in accordance with the requirements and to the satisfaction of the agency having jurisdiction. Street zone backfill can be placed with mechanical compaction.

## N. Compacted Embankment

Earthwork for construction of compacted embankment shall be as specified in Section 02201, Earthwork and Grading.

## O. Import or Export of Backfill Material

1. Excess Material: Excess excavated soil material shall be removed and disposed of off the project site at no additional expense to the District. Excess soil material shall be disposed of in accordance with local regulations.

2. Imported Material: Any additional backfill material necessary to return all grades to plus or minus 0.2 feet from the grade encountered at the beginning of construction or as shown on the contract drawings shall be imported, placed, and compacted at no additional cost to the District. Only approved imported material is allowed.

## P. Moisture Content of Backfill Material

During the compacting operations and under the supervision of an independent geotechnical firm, optimum practicable moisture content required for compaction purposes shall be maintained in each lift of the backfill material. Moisture content throughout the lift shall be maintained at a uniform level. If placement is discontinued and proper moisture content not maintained, the upper layer shall be brought back to proper moisture content by sprinkling, cultivating and rolling the backfill material before placing new material. At the time of compaction, the water content of the material shall be at optimum water content plus or minus two percentage points. Material which contains excessive moisture shall not be worked to obtain the required compaction. Material having excessive moisture content may be dried by blading, discing, or harrowing to hasten the drying process.

**END OF SECTION**

# SECTION 02315

# JACKED CASING

## PART 1 - GENERAL

### A. Description

This section describes tunneling using jacked steel casing for highway, culvert, utility and structure crossings and other shallow depth tunnels less than 500 feet in length. This section also describes carrier pipe installation within the steel casing.

### B. Related Work Specified Elsewhere

1. Trenching, Backfilling, and Compacting: 02223

2. Concrete: 03300

3. Hydrostatic Testing of Pressure Pipelines: 15042

4. Leakage and Infiltration Testing of Non-Pressure Pipelines: 15043

5. Installation of Pressure Pipelines: 15051

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300 and the following.

2. Submit manufacturer's mill specification sheet listing diameter, thickness, and class of steel used in making the casing, and the mill certification.

3. Submit drawings showing the location of approach trench, jacking pit, tunnel and receiving pit, and joint type for both casing and carrier pipe.

4. Submit a tunnel construction schedule which includes casing installation, carrier pipe installation, approach trench backfill, and receiving pit backfill.

### D. Permits

All work shall conform to the specifications and requirements of the State of California Department of Transportation, the Orange County Planning & Development Services Department, the City, or the railroad company involved. The Contractor shall secure all required permits for construction of casing pipe installation.

## E. Alternative Methods (For Pipelines having a Pipe Diameter 10-inches and Under)

The Contractor may present an alternative detailed proposal in lieu of the methods and materials specified herein to jack or bore casing pipe at the locations shown on the plans. Any such proposal shall be presented to the District Representative a minimum of 14 calendar days in advance of the work to allow adequate time for checking, and must be in accordance with all the conditions set forth in the permits.

## F. Scheduling

If the pipeline is not installed within the casing as a continuous operation following completion of the jacking of the casing, the casing portals shall be bulkheaded and the approach trenches backfilled and later reopened for pipe installation.

# PART 2 - MATERIALS

## A. Steel Casing

1. Materials: Steel casing pipe shall have a minimum yield strength of 35,000 psi. The minimum inside diameter and wall thickness of the casing shall be as follows, or shall be as shown on the drawings. Greater casing thickness and diameter may be used as convenient for the method of work and loadings involved, as suitable for the site and as limited by possible interferences, but at no additional cost to District.

   The Contractor shall choose a size of casing at or above the minimum specified, in order that the jacking may be done with a sufficient degree of accuracy to permit installation of the carrier pipe to the grades shown on the plans.

2. Joints: Casing sections shall be joined by full circumference butt welding in the field. Prepare ends of casings for welding by providing 1/4-inch X 45-degree chamfer on outside edges.

3. Wall Thickness: The minimum size and thickness of casing pipes for insertion of various sizes of carrier pipes shall be according to the Standard Drawings, unless a larger or heavier wall casing pipe is required by the agency having jurisdiction over the road or railroad crossings. See Standard Drawing W-13 for casings for water mains, and Standard Drawing S-12 for casings for sewer lines.

## B. Casing Seals

Casing seals shall be 1/8-inch thick, synthetic rubber, designed to fit snugly around pipe and casing. Casing seals may be one piece with no field seams or the wrap-around style to facilitate installation after the casing and carrier pipe are already installed. Bands and hardware for attachment to pipe and casing OD shall be stainless steel.

## C. Grout

1. Grout shall consist of one part portland cement, four parts sand, 2% bentonite by weight of the cement, and sufficient water to produce a workable mixture.

2. Portland cement, water and sand shall conform to the applicable requirements of Section 03300: Concrete, except that sand shall be of such fineness that 100% will pass a standard No. 8 sieve and at least 45%, by weight, will pass a standard No. 40 sieve.

3. Bentonite shall be a commercially-processed powdered bentonite, Wyoming type, such as Imacco-gel, Black Hills, or for Contracts between District and Contractor, approved equal.

## D. Sand

Air blown sand used to fill the annular space in the jacked casing shall conform to the requirements for imported sand in Section 02223, Trenching, Backfilling, and Compacting.

## E. Grout Connections

Two-inch grout connections on the casing pipe shall be provided every four (4) feet at top and bottom of casing, or as shown on the drawings, or as otherwise specified herein. Longitudinal spacing between grout connections may be decreased to provide more frequent grouting, but in no case shall the spacings shown on the drawings or specifications be exceeded.

# PART 3 - EXECUTION

## A. Safety

For contracts between the Contractor and an entity other than the District, the Contractor shall obtain from the Division of Industrial Safety a classification for each bore. For contracts between the Contractor and the District, the District has obtained from the Division of Industrial Safety a classification for each bore where required. The boring and jacking work shall be done in conformance with the State of

California's requirements. It shall be the Contractor's responsibility to call the required safety meeting with representatives from the State Division of Industrial Safety prior to beginning of construction of each bore.

## B. Jacking Pit

1. Excavation Protection: The approach trench for jacking or 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.

2. Structural Support for Jacking Equipment: Heavy guide timbers, structural steel, or concrete cradle of sufficient length shall be placed in the approach trench of the jacking pit and firmly bedded on the required line and grade to provide accurate control of jacking alignment. Adequate space shall be provided to permit the insertion of the lengths of casing to be jacked. The structure of timbers and structural steel sections shall be anchored to ensure action of the jacks in line with the axis of the casing. A bearing block consisting of a timber or structural steel framework shall be inserted between the jacks and the end of the casing to provide uniform end bearing over the perimeter of the casing and distribute the jacking pressure evenly.

## C. Sectional Shield or Jacking Head

1. Equipment: A sectional shield or steel jacking head shall be attached to the leading section of the casing to extend around the outer surface of the upper two-thirds of the casing and to project at least 18-inches beyond the driving end of the casing. The sectional shield or jacking head shall not protrude more than 1/2-inch outside of the outer casing surface. The head shall be anchored to prevent any wobble or alignment variation during the jacking operation.

2. Removal of Excavated Material: To avoid loss of ground outside the casing, excavation shall be restricted to the least clearance necessary to prevent binding, and shall be carried out entirely within the jacking head and not in advance of the head. Excavated material shall be removed from the casing as jacking progresses and no accumulation of excavated material within the casing will be permitted.

## D. Control of Alignment and Grade

Application of jacking pressure and excavation of material ahead of the casing as it advances shall be controlled to prevent the casing from becoming earthbound or deviating from required line and grade. Do not encroach upon the minimum annular space detailed.

## E. Grouting

Immediately after completion of the jacking or boring operation, grout shall be injected through the grout connections in such a manner as to completely fill all voids outside the casing pipe resulting from the jacking or boring operation. Where loss of ground outside the casing is suspected, additional grout connections shall be welded to the casing. Grout pressure shall be controlled so as to avoid deformation of the casing and/or avoid movement of the surrounding ground. After completion of grouting, the grout connections shall be closed with cast iron threaded plugs.

## F. Installation of Carrier Pipe

1. Insertion of Carrier Pipe: After grouting the exterior of the casing pipe, the interior shall be cleaned and the carrier pipe installed. The carrier pipe shall be installed on three (3) skids of sufficient thickness to prevent the pipe bells from touching the casing pipe and to allow for proper alignment of the carrier pipe to meet the specified grade.

2. Securement: The top of the carrier pipe shall be continuously blocked to prevent flotation. The carrier pipe shall be secured in a manner satisfactory to the District Representative to prevent floating and subsequent change of grade when the annular spacing between the casing pipe and the carrier pipe is filled.

3. Pipe Skids and Blocking: Skids and blocking shall be manufactured stainless steel casing spacers with composite runner skids. Casing spacer skids and blocking shall be bolt-on style with a shell made of at least two halves. The band material shall be manufactured of a minimum 14 gauge T-304 stainless steel and 10 gauge T-304 stainless steel risers when needed. All welds are to be chemically passivated. The runners shall be at least 11 inches long and shall be manufactured of high abrasion resistant and low coefficient of friction, glass-filled polymer. Fasteners and hardware for securing the spacers and runners shall be stainless steel. Spacers shall be installed at mid-sections if the carrier pipe segment is over 10 feet long. Detailed product submittals showing all dimensions shall be provided. Casing spacers shall have a flexible EPDM liner having a minimum thickness of 0.090 inch with a hardness of Durometer "A" 85-90. The liner shall have a rating of no less than 60,000 VPM and water absorption of 1% maximum.

   Casing spacers shall be as manufactured by Advance Products & Systems, Inc., Cascade Waterworks Mfg. Co., Pipeline Seal & Insulator, Inc. or approved equal.

4. Grade Adjustment: The carrier pipe grade shall be adjusted as required by either changing the height of the casing spacer riser and/or the thickness of the runner pad skids to compensate for any grade variations of the casing pipe or grouting the invert of the casing pipe to attain the proper grade. Care should be

taken to ensure that the carrier pipe does not come in contact with and is insulated from the casing pipe.

5. Failure to Achieve Required Grade: If the alignment of the casing pipe is such that the carrier pipe grade cannot be met, the grade of the casing pipe shall, if required by the District, be adjusted. If realignment is not deemed feasible by the District, another casing pipe meeting the required grade shall be installed. The abandoned casing pipe shall be filled with sand and the ends plugged with twelve (12) inch thick masonry plugs, brick and mortar plugs or pic seals. Realignment or replacement work shall in no way result in extra cost to the District.

6. Testing: Before backfilling the annular space, the carrier pipe shall have passed an initial pressure or leakage test in accordance with Section 15042 or Section 15043.

## G. Sand Backfill for Annular Space in Jacked Casing

1. Fill for Annular Space: Air-blown sand shall be used to fill the annular space between the casing and the carrier pipe.

2. Equipment: The necessary sand, air compressor, hoses, pressure gages, valves, and fittings shall be furnished for the filling operation.

3. Sand: Sand shall be free of lumps when put into the hopper. Sand shall be of a consistency to flow unimpeded and completely fill all voids.

4. Placement of Sand: A bulkhead for retaining the sand shall be placed in the annular space between the casing and the carrier pipe at each end of the jacked casing. At the start of the sand fill operation, the sand discharge pipe shall extend from the placing equipment, through the inside of the casing, and to the bulkhead at the remote end of the casing. The method used to place the sand shall be such to ensure complete filling of the annular space. During placement, the sand discharge pipe shall be so positioned that its discharge end shall be kept well buried in the sand at all times after the sand has been built up over the crown of the pipe at the remote end of the section being filled. A riser pipe suitable for a vent shall be installed in the casing adjacent to the bulkhead at the near end of the casing. The vent pipe shall be plugged with grout upon completion of sand filling.

## H. Closing the Jacking Pit and Receiving Pit

1. Closing the Jacking Pit and Receiving Pit: After jacking equipment and muck from the tunnel have been removed from the approach trench of jacking pit, the bottom of the jacking pit shall be prepared as for a pipe foundation. Remove all loose and disturbed material below pipe grade to undisturbed earth.

2. Backfill: The jacking pit and receiving pit represent overwidth trench conditions. Backfill shall either be Provisions as called for on the contract drawings, in the Special Provisions, or in Section 02223: Trenching, Backfilling, and Compacting.

**END OF SECTION**

# SECTION 02528

# CONCRETE CURBS, GUTTERS AND SIDEWALKS

## PART 1 - GENERAL

### A. Description

This section describes materials and construction of concrete curbs, gutters, and sidewalks.

Jurisdictional agency permits, where applicable, shall supersede this section.

### B. Related Work Specified Elsewhere

1. Trenching, Backfilling, and Compacting: 02223
2. Concrete Formwork: 03100
3. Concrete Reinforcement: 03201
4. Concrete: 03300
5. Concrete Finishing and Curing: 03345

### C. Submittals

Shop drawings shall be submitted in accordance with Section 01300 and the requirements of Section 03300, Concrete, Part 1-C.

## PART 2 - MATERIALS

### A. Forms

1. General: Forms shall be as required in Section 03100 Concrete Formwork. Stakes and braces shall be provided to hold forms securely in place.
2. Sidewalk Forms: Sidewalk forms shall be 2-inch dressed lumber, straight and free from defects, or standard metal forms. Where short-radius forms are required, 1-inch dressed lumber of plywood may be used.

**B. Aggregate Base Course**

Crushed rock base shall be clean 3/4-inch and smaller crushed rock or crushed gravel, free from foreign material, and conforming to Crushed Aggregate Base as specified by Standard Specifications of Public Works Construction Section 200-2, latest edition.

**C. Expansion Joint Filler**

Premolded expansion joint filler shall be 1/4-inch thick for curbs and 1/4-inch thick for sidewalks, or as required or allowed by the permitting agency.

**D. Concrete**

Conform to Section 03300, Concrete.

**E. Reinforcing Steel**

Conform to Section 03201, Concrete Reinforcement.

**F. Curing Compound**

Conform to Section 03345, Concrete Finishing and Curing.

**G. Excavation and Backfill**

Conform to Section 02223, Trenching, Backfilling, and Compacting.

## PART 3 - EXECUTION

**A. Preparation of Subgrade**

Subgrade shall be excavated and shaped to line, grade, and cross section. The top 12-inches of subgrade shall be compacted to 90% relative compaction. All soft material disclosed by excavating shall be removed and replaced with aggregate base as directed. The finished subgrade shall be within a tolerance of +/-0.02 of a foot of the grade and cross section shown and shall be smooth and free from irregularities at the specified relative compaction. The subgrade shall extend over the full width of the construction. The District Representative's approval of finished subgrades must be received prior to continuance of the work.

## B. Placing Aggregate Base

After the subgrade for curbs, sidewalks, and roadway slabs is compacted and accepted, the Contractor shall place and spread aggregate base material, sprinkle with water, and compact to 90% relative density. The surface of the compacted base shall be at the proper level to receive concrete. Curbs and sidewalks shall be underlain by 4-inches or more of compacted aggregate base material.

## C. Setting Forms

Forms shall conform to Section 03100, Concrete Formwork. Forms for a face-of-curb shall not have any horizontal joints within 7-inches of the top of the curb. Forms shall be braced to prevent change of shape or movement in any direction resulting from the weight of the concrete. Short-radius curved forms shall be constructed to exact radius. Tops of forms shall not depart from gradeline more than 1/8-inch when checked with a 10-foot straightedge. Alignment of straight sections shall not vary more than 1/8-inch in 10-feet.

## D. Curb Construction

1. Jurisdictional Requirements: Curbs shall be reconstructed to original line and grade if removed. Curbs shall conform to the requirements of the respective jurisdictional agency.

2. Expansion Joints: Preformed asphalt-impregnated expansion joints shall be placed at 20-foot intervals, at the beginning and end of curved portions of the curb, at each change in thickness of section, at the end of curbs at buildings and other structures, and at connections to existing curbs.

3. Notification: The District's Representative shall be notified one day in advance of planned concrete placement.

4. Concrete Finish: When the concrete has set sufficiently to support its own weight, the front form shall be removed and exposed surfaces finished. The formed face shall be finished by rubbing with a burlap sack or similar device to produce a uniformly textured surface, free of form marks, honeycomb, and other defects. Defective concrete shall be removed and replaced at no expense to the District. Upon completion of the finishing, curing compound shall be applied to exposed surfaces of the curb. Curing shall continue for a minimum of five days.

5. Backfill: Seven days (minimum) after pouring the concrete, the curb shall be backfilled with earth free from rocks, 2-inches and larger, and other foreign material. Backfill shall be tamped firmly in place.

6. Alignment and Grade: Finished curb shall have a uniform grade and alignment. Any section of curb showing abrupt changes in alignment or grade, or which is more than 1/4-inch away from its intended location, as staked, shall be removed and reconstructed at no additional cost to the District.

7. Protection of Work: All concrete surfaces and/or structures shall be protected until the project containing the work is accepted.

## E. Sidewalk Construction

1. General Requirements: Unless shown otherwise, sidewalks shall be placed in a single pour, 4-inches thick. Walks shall slope 1/4-inch per foot upward from the top of curb. Concrete shall be placed, processed, finished, and cured in conformance with the applicable requirements of ACI 614. For sidewalks within a City or County right-of-way, sidewalk construction shall be in accordance with the jurisdictional agency's requirements.

2. New Sidewalk: Where new sidewalk is to abut existing concrete, the existing concrete shall be sawcut to a depth of 2-inches and the concrete chipped out to sound material and a plane surface. The surface shall be cleaned and a neat cement paste applied just prior to pouring the new sidewalk.

3. Expansion Joints: Preformed expansion joints shall be placed at 20-foot intervals or less to match those in the adjacent curb, where the sidewalk ends at a curb, and around posts, poles, or other facilities located within the sidewalk. Expansion joints shall be placed between sidewalks and buildings or other structures.

4. Contraction Joints: Contraction joints shall be provided transversely to the walks at locations opposite the contraction joints in the curb and at 10-foot intervals along the sidewalk. These joints shall be 3/16-inch by 1-inch weakened plane joints. They shall be straight and at right angles to the top of the walk.

5. Notification: The District's Representative shall be notified one day in advance of planned concrete placement.

6. Concrete Finish: The top surface of the sidewalk shall receive a broom finish with a fine-hair broom in line with the length of the walk. All edges, joints, and markings shall be tooled. The walk shall be scored transversely at 5-foot intervals with a jointing tool. Upon completion of the finishing, an approved curing compound shall be applied to exposed surfaces. Sidewalks shall be protected from damage until final acceptance.

**END OF SECTION**

# SECTION 02578

# PAVEMENT REMOVAL AND REPLACEMENT

## PART 1 - GENERAL

### A. Description

This section describes materials, testing, removal, and replacement of asphalt concrete pavement, seal coat, aggregate base course, prime coat, tack coat, and portland cement concrete surfaces.

Jurisdictional agency permits, where applicable, shall supercede this section.

### B. Related Work Specified Elsewhere

1. Trenching, Backfilling, and Compacting: 02223

2. Concrete Curbs, Gutters, and Sidewalks: 02528

3. Standard Specifications for Public Works Construction, latest edition

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300 and the following.

2. Submit information on material sources, designs, and quality certifications.

## PART 2 - MATERIALS

### A. Asphalt Concrete Paving

Asphalt concrete paving shall be Type III-C2-PG 64-10 as listed in Section 203-6 of the Standard Specifications for Public Works Construction for dense grade paving. Asphalt binder content in the pavement shall be 5.5% to 6.5%.

### B. Aggregate for Asphalt Concrete

Aggregate shall be in accordance with Section 203-6.2 of the Standard Specifications for Public Works Construction.

## C. Seal Coat

Seal coat shall be SS1 asphaltic emulsion.

## D. Aggregate Base Course

Aggregate base shall be crushed aggregate base as specified in Section 200-2.2 of the Standard Specifications for Public Works Construction.

Crushed miscellaneous base material may be substituted for crushed aggregate base materials by special permission from the District. In such cases, materials shall conform to the requirements of the Standard Specifications for Public Works Construction, Section 200-2.4.

## E. Prime Coat

All aggregate base areas to be paved over shall receive prime coat. Prime coat shall be medium curing (MC-70) in accordance with Section 203-2 of the Standard Specifications for Public Works Construction.

## F. Tack Coat

Tack coat shall conform with Section 302-5.4 of the Standard Specifications for Public Works Construction.

# PART 3 - EXECUTION

## A. Pavement Removal

1. Asphalt Concrete Pavement Cutting Requirements: Asphalt concrete pavement shall initially be cut with a pavement cutter or other equipment at the limits of the excavation before the pavement is removed. After backfilling and compacting the excavation, asphalt concrete pavement shall be ground to a minimum depth of 2-inches at a point not less than 12-inches outside the limits of the excavation or the previous pavement cut, whichever is greater, and the additional pavement removed. If the cut is within 3-feet of an existing joint or curb and gutter, the asphalt concrete pavement shall be replaced to the joint or curb and gutter.

2. Portland Cement Concrete Pavement Cutting Requirements: Concrete pavement, cross gutters, curbs and gutters, sidewalks, or driveways, shall be saw cut to a minimum depth of 1-1/2-inches at a point 1-foot beyond the edge of the excavation and the strip of improvement removed. Concrete pavement may initially be cut at the limits of the excavation by other methods prior to

removal and the saw cut made after backfilling the excavation. If the saw cut falls within 3-feet of a concrete joint or pavement edge, the concrete shall be removed and replaced to the joint or edge.

3. Disposal of Material: All pavement and other improvements removed shall be disposed of off the site. The cost of such disposal shall be included in the appropriate bid item.

4. Pavement Saw Cuts: Excavation shall be regular and rectangular in shape and shall be blade cut or saw cut, as appropriate to the field conditions through the existing pavements. Cuts shall be made in straight lines. Adjoining pavement which has been damaged or disturbed shall also be saw cut and removed.

## B. Pavement Replacement

1. General: Producing, hauling, placing, compacting, and finishing of asphalt concrete shall conform to Section 302-5 of the Standard Specifications for Public Works Construction. Seal coat shall be applied to all new asphalt concrete paving, except open grade asphalt concrete.

2. Base Coarse, Final Course and Striping: Base course paving shall be complete at all times to a point not to exceed 1,000 feet behind any working heading. The final asphalt surface course shall be at least 2-inches thick and shall be placed within a period of two weeks after traffic has been returned to that portion of the street. Temporary striping shall be applied after the base course of asphalt concrete pavement has been placed, in the same configuration as the existing permanent striping, so that traffic can be returned to normal patterns. Temporary striping shall be maintained until permanent striping is applied.

## C. Preparation of Subgrade

The subgrade shall be compacted to 90% relative compaction. All soft material disclosed by the compacting effort shall be removed and replaced. The finished subgrade shall be smooth and free from irregularities and at the specified relative compaction. The subgrade shall be considered to extend over the full width of the aggregate base course.

## D. Placing Aggregate Base

Aggregate base shall be placed to thickness shown on the plans, to match existing, or per the applicable permit. Aggregate base shall be compacted to 95% relative compaction and installed in accordance with Section 301-2 of the Standard Specifications for Public Works Construction.

## E. Placing Prime Coat

Prime coat shall be applied to the surface of the final aggregate base course at the rate of 0.25 gallon per square yard per Section 302-5.3 of the Standard Specifications for Public Works Construction.

## F. Placing Tack Coat

Tack coat shall be applied at the rate of 0.05 gallons per square yard to the surfaces to receive finish pavement per Section 302-5.4 of the Standard Specifications for Public Works Construction. Tack coat shall be applied to existing asphalt, metal, or concrete surfaces that will be in contact with new asphalt concrete paving.

## G. Placing Asphalt Paving

Asphalt paving shall be applied to the thickness shown on the plans, as listed above, or per the applicable permit. Asphalt paving shall be installed in accordance with Section 302-5 of the Standard Specifications for Public Works Construction.

## H. Applying Seal Coat

Seal coat shall be applied at the rate of 0.05 to 0.10 gallon per square yard.

## I. Compaction of Base and Leveling Courses

Compaction and rolling of base and leveling courses shall begin at the outer edges of the surfacing and continue toward the center. Water shall be applied uniformly throughout the material to provide moisture for obtaining the specified compaction. Each layer shall be compacted to the specified relative compaction before the next layer is placed.

## J. Surface Tolerance

Finished grade shall not deviate more than 0.02 foot in elevation from the grade indicated on the drawings. Slopes shall not vary more than 1/8-inch in 10 feet from the slopes shown on the drawings.

## K. Concrete Curbs, Gutters, and Sidewalks

Concrete curbs, gutters, and sidewalks shall be replaced in accordance with Section 02528, Concrete Curbs, Gutters, and Sidewalks.

## L. Emulsion-Aggregate Slurry

Certain street sections where shown on the plans or where required by the jurisdictional agency may be required to receive an asphaltic slurry seal in conformance with Section 302-4, Standard Specifications for Public Works Construction after the final asphalt surface course. The composition and aggregate grading for slurry shall be Type II of Subsection 200-1.7.

**END OF SECTION**

# SECTION 02701

# INSTALLATION OF GRAVITY SEWER PIPELINES

## PART 1 - GENERAL

### A. Description

This section describes the installation of gravity sewer pipelines fabricated of vitrified clay pipe (VCP), ductile iron pipe (DIP) and polyvinyl chloride (PVC) pipe.

### B. Related Work Described Elsewhere

1. Trenching, Backfilling and Compacting: 02223
2. Jacked Casing: 02315
3. Vitrified Clay Pipe: 02710
4. PVC Pipe and Fittings for Gravity Sewers: 02715
5. Concrete: 03300
6. Precast Concrete Manholes and Manhole Bases: 03461
7. Leakage and Infiltration Testing: 15043
8. Water & Sewer Facilities Identification: 15151

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300 and the following:
2. An installation schedule (tabulated layout) shall be submitted which includes:
    a. Order of installation and closures.
    b. Pipe centerline station and elevation at each change of grade and alignment.
    c. Locations of manholes.

## PART 2 - MATERIALS

### A. Installation Material

Refer to Section 02710, Vitrified Clay Pipe and Section 02715, PVC Pipe and Fittings for Gravity Sewers, for material requirements.

### B. Piping Schedule

Unless noted otherwise on the plans or in the specifications, pipe shall be furnished in accordance with the following materials schedule:

| **Diameter** | **Gravity Sewer** |
|---|---|
| 4-inch through 12-inch | PVC SDR 35<br>For depths 20-feet and deeper: Green-Colored PVC C900 DR 14 or DR 18<br>Extra-Strength VCP (For industrial, commercial and medical applications only as determined by the Engineering Manager) |
| 14-inch through 24-inch | Green-Colored PVC C900 DR 18<br>Extra-Strength VCP (For industrial, commercial and medical applications only as determined by the Engineering Manager) |
| Larger than 24-inch | Per plan or specifications |

Notes: VCP – Vitrified clay pipe per Section 02710.
PVC – Polyvinyl chloride pipe per Section 02715.

### C. Couplings

Couplings used to join various types of 12-inch and smaller pipe shall be banded rubber repair type couplings with continuous stainless steel shear rings as manufactured by Mission Clay Products, Fernco, or approved equal.

## PART 3 - EXECUTION

### A. Delivery and Temporary Storage of Pipe at Site

1. Onsite Storage Limitation: Onsite pipe storage shall be limited to a maximum of one week, unless exception is approved by District.

2. Care of Pipe: At times when the pipe laying is not in progress, the open end of the pipe shall be closed with a tight-fitting cap or plug to prevent the entrance of foreign matter into the pipe. In addition, all pipe stored onsite shall be protected from the sun via canvas or other opaque material to prevent UV degradation. Placement of this material shall allow for adequate air circulation between the cover and the pipe. These provisions shall apply during daylight hours as well as overnight. In no event shall the sewers be used as drains for removing water which has infiltrated into the construction trenches.

## B. Handling of Pipe

1. Moving Pipe: Pipes shall be lifted with handling beams or wide belt slings as recommended by the pipe manufacturer. Cable slings shall not be used. Pipe shall be handled in a manner to avoid damage to the pipe. Pipe shall not be dropped or dumped from trucks or into trenches under any circumstances.

2. Inspection of Pipe: The pipe and accessories shall be inspected for defects prior to lowering into the trench. Any defective, damaged or unsound pipe shall be repaired or replaced. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench.

## C. Placement of Pipe in Trench

1. General: All pipe shall be laid without a break, upgrade from structure to structure, with the bell ends of the pipe upgrade. Pipe shall be laid to the line and grade given so as to form a close concentric joint with the adjoining pipe and prevent sudden offsets of the flow line.

2. Trench Excavation: Dewatering, excavation, shoring, sheeting, bracing, backfill material placement, material compaction, compaction testing, and pipe laying requirements and limitations shall be in accordance with Section 02223, Trenching, Backfilling, and Compacting.

3. Pipe Base and Pipe Zone Material: Unless shown otherwise on the drawings, pipe base and pipe zone material shall be 3/4-inch crushed rock for VCP, 3/4-inch crushed rock or imported sand for PVC, as specified in Section 02223, Trenching, Backfilling, and Compacting.

4. Subgrade at Joints: At each joint in the pipe, the pipe subgrade shall be recessed in firm bedding material so as to relieve the bell of the pipe of all load and to ensure continuous bearing along the pipe barrel.

5. Cleaning: The interior of the sewer pipe shall be cleaned of all dirt and superfluous materials as the work progresses.

6. Joints: The mating surfaces of the pipe to be joined shall be wiped clean of all dirt and foreign matter and a lubricant applied that is approved by the pipe manufacturer. Then, with the surfaces properly lubricated, the spigot end of the pipe shall be positioned inside the bell and the joint shoved home. For larger diameter pipe where a lever attachment is required, the necessary precautions shall be taken to insure an undamaged pipe installation.

7. Pipe Alignment: Unless specified otherwise, pipeline line and grade shall be as shown on the plans. Grade shall be measured along the pipe invert.

8. PVC Pipe Curvature: Refer to Section 02715, PVC Pipe and Fittings for Gravity Sewer. Construction of curved reaches of PVC pipe may be accomplished by deflecting joints. Pipe deflection to achieve horizontal curves shall be limited by the manufacturer's maximum recommended limit or as follows, whichever provides the largest radius and the least deflection:

| Pipe Size (inches) | Minimum Radius (feet) |
|---|---|
| 6 | 210 |
| 8 | 280 |
| 10 | 350 |
| 12 | 420 |

9. Short Lengths of VCP Pipe: When using VCP, two 2-foot lengths of sewer pipe shall be used to provide curve flexibility and prevent cracking or shearing failures as shown on the plans or as may be required by the District Representative during construction. The use of short lengths of pipe is particularly required, but not necessarily limited to these locations: (1) inlets and outlets to all manholes; (2) ends of steel casing pipe; (3) ends of concrete encasement; (4) vertical and horizontal curvilinear sewers; and (5) deep lateral connections.

10. Buried Piping Detectable Warning Tape: Detectable warning tape shall be installed on all pipelines. The pipe identification and installation of the detectable warning tape shall be in accordance with Section 15151: Water & Sewer Facilities Identification.

11. Laterals: VCP and PVC wyes, and other types of branches shall be furnished and installed along with the VCP or PVC sewer main, respectively. Wyes sized as specified on the plans shall be installed for all sewer lateral connections and for future sewer lateral connections as shown on the plans. The longitudinal barrel of branch fittings, to be placed in line and grade with the sewer mains, shall be of the same diameter, quality, and type as specified herein for sewer installations. Earthwork and bedding for branches shall conform to the applicable provisions set forth for each pipe material. Unless otherwise specified, the branch of wye fittings shall be inclined upward at an angle not greater than 45 degrees from a horizontal line. No wye for sewer

lateral branch shall be placed closer than 5 feet downstream of the centerline of any structure. The Contractor shall place a support of graded, ¾-inch crushed rock under every VCP wye branch and imported sand under every PVC wye branch, when installed. The support shall be placed in accordance with YLWD Standard Drawings, the detail on the plans, or as specified in Section 02223, Trenching, Backfilling, and Compacting.

12. Backfill: Backfill shall be placed and compacted in accordance with the requirements of Section 02223, Trenching, Backfilling and Compacting, and as shown on YLWD Standard Drawings.

## D. Manholes and Manhole Bases

Precast concrete manholes and manhole bases shall be constructed in accordance with Section 03461, Precast Concrete Manholes and Manhole Bases, as shown in the plans or on YLWD Standard Drawings.

## E. Sewer Laterals

1. Locations: Sewer laterals and wye branch fittings of the size indicated on the plans shall be installed at the locations shown on the plans or at the location furnished by the District Representative.

2. Wye-Branches for Future Laterals: All branch fittings that are to be left unconnected shall be plugged with a manufactured plug in accordance with the District Standard Drawings and as approved by the District Representative.

3. Fittings: Sewer laterals shall be joined to wye branch fittings at the sanitary sewer main as set forth above by eighth bends.

4. Alignment: Where possible, all sewer laterals shall run perpendicular to the sewer main from the main to the property line.

5. Plugged Sewer Laterals: All sewer laterals shall be plugged with an approved stopper or cap at the last joint of each lateral. It shall withstand the internal pressure during the test for leakage. It shall be installed in such a manner that it may be removed without damaging the pipe.

6. Marking: The Contractor shall mark the location of each sewer lateral at its upstream end by chiseling a 2-inch high letter "S" on the face of the curb (where a curb exists).

7. PVC Sewer Laterals on VCP Sewer Mains: For single sewer residential connections, PVC SDR 35 lateral pipe material may be used on existing VCP sewer mains. The Contractor shall install VCP wye connection, eighth bend, 4 foot-long VCP pipe stub and transition coupling prior to the PVC pipe

material. The transition coupling shall be either banded rubber repair type coupling with continuous stainless steel shear ring and transitional bushing, or flexible PVC coupling. Both couplings shall have stainless steel clamps.

8. Chimney Connections: Chimney connections are not allowed.

## F. Saddle Connections

1. General: All saddle connections into existing sewer lines shall be made with a wye saddle.

2. Scoring and Tapping: The sewer line to be saddled shall be scored to the approximate shape of wye or tee and shall be cut with a hole cutter. The tap holes shall be cleanly machined and may be further worked by hand to provide a true and neat opening for the collar wye or tee saddle. Pipe damaged during this operation shall be repaired or replaced. The District Representative shall be the sole judge as to the method of repair or replacement.

3. Securement: The collar wye shall be secured to the sewer main with a catalytic epoxy resin. The saddle shall be tied to the main with wire of sufficient strength that no movement will occur during the setting of the epoxy resin.

4. Encasement: After the connection has set sufficiently long for the epoxy resin to cure, the District will inspect the connection and, if satisfactory, the Contractor shall encase the fitting with Class A portland cement concrete to the limits indicated on Standard Drawing S-7.

5. Cleaning: The saddling operation shall be carried out in a workmanlike manner. Chips, dirt, epoxy mortar, and concrete shall be kept out of the sewer line being saddled. If directed by the District Representative, the reach of sewer main saddled shall be flushed, cleaned, and balled.

6. Alternative Connection: In lieu of a saddle connection, a cut-in wye connection may be made by cutting the sewer and installing a cut-in wye as detailed on Standard Drawing S-7.

## G. Installation Within Jacked Casing

1. General: Sewer carrier pipe shall be installed within the casing pipe to the lines and grades shown on the plans and in accordance with Section 02315, Jacked Casing.
2. Pipe Support: The sewer carrier pipe shall be supported on skids, before backfilling, in such a manner as to relieve the pipe bells from any bearing loads. Pipe skids for “carrier pipe” shall be as specified in Section 02315, Jacked Casing, and as shown in the District Standard Drawings.

3. Annular Casing Space: The annular space between the casing and the sewer carrier pipe shall be backfilled per Section 02315, Jacked Casing.

4. Testing: Before backfilling as specified above, the sewer carrier pipe shall pass an initial test for leakage as provided in Section 15043, Leakage and Infiltration Testing.

## H. Pipe Anchorage (For Pipelines Having a Diameter of 10-Inches or Less)

1. General: Concrete pipe anchors shall be installed where shown on the plans in accordance with Section 03300 and Standard Drawing S-11. They shall be installed wherever the profile of the ground surface above the sewer main exceeds 20 percent, and where no pavement or other surfacing is to be laid over the facility.

2. Dimensions: Anchors shall be a minimum of 18-inches thick underneath the pipe, and shall extend at least 12-inches into undisturbed material on each side of the trench as excavated.

3. Slope Protection: Any required surface slope protection shall be reviewed and approved in advance by the District.

4. Spacing: Spacing between pipe anchors shall not exceed the distances shown in Standard Drawing S-11.

5. Reinforcement for Concrete Anchors: Anchors constructed of cast-in-place reinforced concrete shall have No. 4 reinforcing steel bars placed at 6-inches on center each way in the center of the anchor thickness. Refer to Standard Drawing S-11 for the reinforcing steel bar pattern.

6. Reinforcement for Concrete Masonry Unit Anchors: Reinforced hollow masonry units shall have all cells filled solidly with grout. A No. 4 reinforcing bar shall be placed vertically in each row of cells and No. 9 gage wall mesh shall be placed in each horizontal joint. In addition, a bond beam shall be placed at the top with two No. 4 bars.

## I. Concrete Encasement

Unless shown otherwise, concrete for encasement shall be reinforced or unformed or rough formed, and of the class as designated on the plans. Concrete shall be in accordance with Section 03300, Concrete. Concrete used for encasing, cradling, bedding, cover for pipe, or other objects shall be as specially designed by the Engineer, or as directed by the District Representative. Encasement is by special permission from the District and in no case shall it be installed on VCP sewer pipes.

## J. Cleaning

Before testing, each pipe shall be thoroughly cleaned from manhole to manhole with a sewer scrubbing ball, and all debris and trash shall be removed from each manhole.

## K. Mandrel Test for PVC Gravity Sewers

Following placement and compaction of backfill for all utilities, and prior to the placement of permanent pavement, all PVC sewer mains shall be cleaned and mandrelled to verify that the pipeline is free from obstructions (deflections, joint offsets, lateral pipe intrusions, etc.). A rigid mandrel, with a circular cross section having a diameter of at least 95 percent of the specified inside pipe diameter, shall be pulled through the pipe by hand. The minimum length of the circular portion of the mandrel shall be equal to the nominal diameter of the pipe. Obstructions encountered by the mandrel shall be repaired and the pipeline section retested.

## L. Leakage and Infiltration Test

The pipe, manholes, and other appurtenances shall be tested for leakage and infiltration per Section 15043, Leakage and Infiltration Testing.

## M. Closed-Circuit Television Inspection

1. CCTV Operator(s) shall be NASSCO ISO 14001 PACP and ITCP Certified and have a minimum of 5 years' experience in the videotaping and documenting sewer line and manhole defects for municipal agencies.

2. In addition to the regular leakage and infiltration test, all new sewer lines shall be inspected using closed-circuit television (CCTV) equipment. The inspection shall be conducted after all utilities have been installed, leakage and infiltration testing have been completed, and prior to paving.

3. The inspection shall be conducted by an independent CCTV specialist retained by the contractor. The CCTV inspection equipment shall be equipped with an inclinometer and a two port DVD.

4. The Contractor shall provide a valid PACP 7 format data exchange file to the District, either through a file transfer protocol site or as two original DVDs.

5. Along with the PACP 7 format data exchange file, the Contractor shall provide logs of the video inspection and two hardcopies of the Report for review. If the Contractor provides a DVD of such poor quality that it cannot be properly evaluated, the Contractor shall re-record as necessary and provide a DVD of good quality at no additional cost to the District. If the Contractor cannot provide a DVD of such good quality that can be reviewed by the District, YLWD may elect to video record the line at the Contractor's expense.

6. The television unit shall also have the capability of displaying in color, pipe inspection observations such as pipe defects, sags, and points of root intrusion, offset joints, service connection locations, and any other relevant physical attributes in a data DVD format. Each DVD shall be permanently labeled with the following:

   Project name;
   Yorba Linda Water District Job Number;
   Date of video inspection;
   Station to station location and size of sanitary sewer;
   Street/easement location;
   Name of Contractor;
   Date of submittal; and
   DVD number (i.e., 1 of 2)

7. The Contractor shall provide a line diagram area sketch and written log for each completed segment of video recorded sewer main describing the section being televised, flow and camera direction, position of service connections, description and location of failures, pipe condition, weather conditions, and other significant observations.

8. The television inspection equipment shall have an accurate footage counter which displays on the monitor the exact distance of the camera from the center of the starting manhole. A camera with rotating and panning lens capabilities is required. The camera height shall be centered in the conduit being televised. The speed of the camera through the conduit shall not exceed 30 feet per minute.

9. The Contractor shall be required to have all materials, equipment, and labor force necessary to complete all CCTV inspection on the job site prior to isolating the sewer manhole segment and beginning video recording operations. CCTV camera shall be explosion proof.

10. Television inspection shall be done one manhole section at a time, and the flow in the section being televised shall be bypassed if the line is in service and the flow exceeds 25% of the internal pipe diameter. When the depth of flow at the upstream manhole of the manhole section being worked is above the maximum allowable for television inspection, the flow shall be reduced to allowable levels by temporarily plugging or blocking the flow or bypass pumping, as approved by the District.

11. The Contractor shall not be allowed to float the camera. There may be occasions during the televised inspection of a manhole section when the camera will be unable to pass an obstruction. At that time, and prior to proceeding, the Contractor shall contact the District. If the length of sewer line

cannot be televised because of obstructions, the Contractor shall clean the system as necessary. If, in the opinion of the District, the obstruction is attributed to a collapsed main or pipe deflection, televising shall be suspended, and the remaining televising of the sewer line shall be continued upon successful correction of the blockage by the Contractor at his expense.

12. The Contractor is solely responsible for any damage and repair of sewer mains as a direct result of video recording operations.

13. Results shall be provided to the District that verifies the sewer has been constructed to District standards for line, grade and quality.

14. All necessary repairs shall be made at no additional expense to the District. Upon completion of repairs, segment shall be re-recorded for inspection, repeating the process until successful passing, at no additional cost to the District.

15. Notification: Notification for sewer line CCTV inspection shall be made to the District Representative a minimum of two working days in advance of the inspection such that the District Representative may be in attendance during all CCTV work.

16. Repair of Defects: Even though the sewer line may have successfully passed the leakage and infiltration tests, any defects in the line shall be repaired to the satisfaction of the District at no additional costs to the District. Following repair, mandrel testing and CCTV inspection shall again be conducted for the repaired pipeline section and these re-inspection costs shall be the sole responsibility of the contractor.

## N. Final Inspection

After paving has been completed and all manholes raised to grade (where required), a final visual inspection shall be made. The necessary labor shall be furnished to assist the District Representative in making the final inspection. Additional balling may be required if the lines are dirty, even though lines were previously balled. The Contractor shall furnish a responsible person or supervisor for the final inspection to remove manhole covers and to note any corrections required by the District Representative in order to obtain final approval. Final District inspection shall be requested through the District Representative by giving at least one day advance notice.

**END OF SECTION**

# SECTION 02710

# VITRIFIED CLAY PIPE

## PART 1 - GENERAL

### A. Description

This section describes materials, testing, and installation of vitrified clay pipe (VCP) and fittings for sanitary sewers.

### B. Related Work Specified Elsewhere

1. Trenching, Backfilling and Compacting: 02223
2. Jacked Casing: 02315
3. Installation of Gravity Sewer Pipelines: 02701
4. Concrete: 03300
5. Precast Concrete Manholes and Manhole Bases: 03461

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300 and the following.
2. Provide certificates of compliance with all standards referenced in this section to the District.
3. Provide copies of the manufacturer's required tests to the following conducted on project pipe:
    a. Crushing test.
    b. Record of retests and rejections.

### D. Inverted Siphons

Inverted siphons will be permitted only at those locations approved by the District, and if no other option is available.

## E. Measurement and Payment

1. Payment for work in this section shall be in accordance with the General Provisions and the following.

2. Payment shall be by the linear foot for each diameter and for each pipe strength designation measured horizontally over the pipe centerline, exclusive of the distance between the inside faces of each structure, manhole or other similar connecting structure. Unless otherwise specified herein, no additional payment shall be made for curved or radius pipe. Such pipe shall be measured and paid for in the same manner as described above for straight pipe.

# PART 2 - MATERIALS

## A. Vitrified Clay Pipe

1. General: All VCP and fittings shall be of one class; designated extra strength; of the best quality; vitrified; homogenous in structure; thoroughly burned through their entire thickness; impervious to moisture; sound; and free from cracks, checks, blister, broken extremities, or other imperfections. Pipe ends shall be square with the longitudinal axis, and sockets shall be true, circular, and concentric with the barrel of the pipe. The thickness of the shell, the depth of the socket, and the dimension of the annular space shall be within the limits of permissible variation to dimension standards of the specifications of ASTM C700, for the size of pipe indicated on the plans.

2. Pipe Marking: All pipe or fittings shall be clearly marked with the name of the manufacturer or with a trademark and with the size and strength of the pipe as shown on the plans and as herein specified.

3. Testing: Before being used in any work under these specifications, pipe shall be subjected to and shall meet the requirements of the following hydrostatic pressure test and loading test; these tests shall be witnessed by a reputable testing laboratory. Pipe selected for testing shall be delivered to the place and at the time designated by the testing laboratory. All costs of furnishing, transporting, and handling the pipe for testing and conducting the tests shall be borne by the Contractor.

   In lieu of witnessing by a testing laboratory, a certified statement from the pipe manufacturer may be furnished stating that all prescribed tests have been made and the pipe to be used on the project has met all requirements of the specifications.

   The testing laboratory shall select, at random, for testing as herein specified, no less than 1% of the number of pipe sections in each size of pipe furnished.

The specimens selected for testing shall be sound pipe having dimensions consistent with these specifications. The lot or lots from which the tests samples are taken shall be sufficient to fill the entire order for that size of pipe used in the work under the contract and, if they pass the tests, shall be so designated and marked.

All pipe shall be subject to inspection at the factory, trench, or other point of delivery by the District Representative. The purpose of the inspection shall be to cull and reject any pipe that, independent of the physical tests herein specified, fails to conform to the requirements of these specifications or that may have been damaged during transportation or in subsequent handling.

In lieu of the standard ASTM absorption test, the ASTM C301 hydrostatic pressure test shall be substituted. The hydrostatic pressure test shall precede the loading test by not less than one hour or more than three hours and shall be applied to all the specimens received for test in each size of pipe.

The loading test shall be the 3-edge bearing test. The loading tests shall conform to the applicable provisions of ASTM C301 and shall be applied to all specimens selected for testing, except that loading to test ultimate strength will not be required.

If all of the minimum designated percentage or number of the specimens tested meet the requirements of the test, then all of the pipe in the lot, shipment, or delivery corresponding to the sizes and classes so tested shall be considered as complying with the test. If, however, 10% or more of the specimens tested fail to meet the requirements of the test or if more than one specimen fails to meet the requirements of the test when the number to be tested is less than ten, then a second selection of pipe shall be made for that test.

The number of specimens to be tested in the second selection of pipe shall be five for each specimen of the first selection that failed to meet the requirements.

If 90% or more of the specimens tested, including those first tested, meet the requirements of the test, all the pipe in the lot, shipment, or delivery corresponding to the sizes and classes so tested shall be considered as complying with that test, otherwise all pipe of these sizes and classes shall be rejected.

4. Causes for Rejection: The following imperfections in a pipe or special fitting shall be considered injurious and cause for rejection without consideration of the test results specified above.

A single crack in the barrel of the pipe will cause rejection.

Surface imperfections, such as lumps, blisters, pits or flakes, on the interior surface of a pipe or fitting shall cause rejection.

When the bore or socket of the pipe varies from a true circle more than 3% of its nominal diameter, it shall be rejected.

The pipe or fitting shall be rejected if it is designated to be straight and it deviates from a straight line more than 1/16-inch per lineal foot. The deviation shall be measured from a straight edge at a point midway between the ends of the pipe.

A joint of pipe with a piece broken from either the socket or spigot end shall be rejected.

Pipe joints that have tramp clays, grog or other foreign matter flushed permanently to the exterior or interior surface of the pipe or fittings shall be rejected.

5. Joints: All VCP pipe joints shall be of the bell and spigot compression type, equal to "Speed Seal" manufactured by Gladding, McBean, or polyurethane compression joints manufactured by Mission Clay Products, or for contracts between District and Contractor, approved equal. The compression joint on the spigot and bell ends of the pipe shall be factory made of plastisol, polyurethane elastomer, or other approved resilient element bonded onto the outside of the spigot and the inside of the bell to the pipe and molded and cured to a uniform hardness and compressibility to form a tight compression coupling when assembled. Materials for compression joints shall conform to ASTM C425.

   VCP pipe joints of mechanical compression coupling type can also be utilized. Joints shall be “Band-Seal” manufactured by Mission Clay Products, or for contracts between District and Contractor, approved equal. Field joints are made by tightening the stainless steel nut and bolt take-up after pipe has been properly assembled. Joints shall conform to the material and performance standards of ASTM C425.

   Where pipe from different manufacturers is to be joined together, an adapter pipe with the proper matching joint on each end for the respective manufacturer shall be used. Hot poured joints or concrete encasement of plain end joints shall not be permitted.

6. Branches: Branches of the type shown on the plans shall be furnished with connections of the sizes specified and shall be securely and completely fastened to the barrel of the pipe in the process of manufacture. Tee branches shall have their axis perpendicular to the longitudinal axis of the pipe. Wye branches shall have their axis approximately 45 degrees (unless otherwise specified on the plans) to the longitudinal axis of the pipe, measured from the

socket end. All branches shall terminate in sockets and the barrel of the branch shall be of sufficient length to permit making a proper joint.

7. Stoppers: The stoppers for all pipe 8-inches in diameter and smaller, in which a sealing component for a flexible compression-type joint is cast, shall be neoprene, polyethylene, or polyurethane. Stoppers in all other cases shall be discs of the same material as the pipe, equal in diameter to the outside of the pipe barrel, and made and installed as approved by the District Representative.

   Neoprene stoppers shall be manufactured from a compound containing not less than 50 percent neoprene by volume, which shall be the sole elastomer. Stoppers shall not be adversely affected when exposed to the chemical and bacteriological environments normally found in wastewater sewers. Neoprene stoppers shall be manufactured by Mission Clay Products, Gladding McBean, or approved equal.

   When installed and braced in place in branch spurs, stoppers shall withstand a hydrostatic pressure test of 10 psi with no leakage. When unbraced, stoppers shall remain in place when subject to a maximum air pressure test of 5 psi.

8. Manufacturers: Vitrified clay pipe shall be manufactured by Mission Clay Products, Gladding McBean, or approved equal.

**B. Precast Concrete Manholes**

Precast concrete manholes, including drop manholes, shall conform to Section 03461, Precast Concrete Manholes and Manhole Bases.

**C. Epoxy Resin**

All approved saddle connections to District sewer mains shall be accomplished with an approved epoxy resin. Epoxy resin shall be Epibond 157 as manufactured by Furane Plastics, Inc., WR633 A&B as manufactured by Wyndham Chemicals, Inc., EPON 828 as manufactured by Shell Chemical Corporation, or approved equal. The epoxy resin shall be used in strict accordance with the manufacturer's specifications.

## PART 3 - EXECUTION

**A. Related Installation Specification**

1. VCP pipe shall be installed in accordance with the requirements of Section 02701, Installation of Gravity Sewer Pipelines.

2. All new sewer lines shall be inspected using closed-circuit television equipment, as specified in Section 02701, Installation of Gravity Sewer Pipelines.

**END OF SECTION**

# SECTION 02715

# PVC PIPE AND FITTINGS FOR GRAVITY SEWERS

## PART 1 - GENERAL

### A. Description

This section includes materials, testing, and installation of polyvinyl chloride (PVC) gravity sewer pipe and fittings.

### B. Related Work Described Elsewhere

1. Trenching, Backfilling and Compacting: 02223
2. Jacked Casing: 02315
3. Installation of Gravity Sewer Pipelines: 02701
4. Vitrified Clay Pipe: 02710
5. Concrete: 03300
6. Precast Reinforced Concrete Manholes and Manhole Bases: 03461
7. Leakage and Infiltration Testing of Non-Pressure Pipelines: 15043

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300 and the following:
2. An installation schedule (tabulated layout) shall be submitted which includes:
    a. Order of installation and closures.
    b. Pipe centerline station and elevation at each change of grade and alignment.
    c. Locations of manholes.
3. Provide materials list showing material of pipe and fittings with ASTM references and grade.
4. Provide certificates of compliance with all standards referenced in this section.

## D. Application

1. Limitations: For industrial, commercial, and medical applications, extra strength VCP may be used as an alternative to PVC if the discharge characteristics are incompatible with PVC as determined by the Engineering Manager.

2. Pipe Material Transitions: Sewer pipe material shall remain constant between manholes. Pipe material transitions shall be made only at manholes.

# PART 2 - MATERIALS

## A. Pipe and Fittings

1. ASTM Requirements: Pipe, fittings, couplings, and joints shall be in conformance with the size, material and performance requirements of ASTM D 3034, SDR 35, DR 14 and DR 18 and shall have gasketed joints.

   Pipe shall be made of PVC plastic having a cell classification of 12454-B, 12454-C, or 13364-B as defined in ASTM D 1784. All pipes shall be of solid wall construction with smooth interior and exterior surfaces.

   Fittings shall be made of PVC plastic having a cell classification of 12454-B, 12454-C, or 13343-C.

2. Manufacturer's Testing Certification: During production of the pipe, the manufacturer shall perform the specified tests for each pipe marking. A certification by the manufacturer indicating compliance with specification requirements shall be delivered with the pipe. The certification shall include the test result data.

3. Pipe Marking: All pipe, fittings, and couplings shall be clearly marked at an interval not to exceed 5-feet as follows:

   a. Nominal pipe diameter.

   b. PVC cell classification.

   c. Company, plant, shift, ASTM, SDR, and date designation.

   d. Service designation or legend.

   For fittings and couplings, the SDR designation is not required. All pipe shall have a home mark on the spigot end to indicate proper penetration when the

joint is made. Fittings shall be marked with raised molding markings on two sides (diametrically opposite from each other) showing the manufacturer's identification information.

4. Additional Pipe Tests Following Delivery: When pipe is delivered to the jobsite, the District Representative may require additional testing to determine conformance with the requirements of pipe flattening, impact resistance, pipe stiffness, and extrusion quality.

   When testing is required, one test pipe shall be selected at random by the Engineering Manager from each 1,200 feet or fraction thereof each size of pipe delivered to the jobsite, but not less than one test pipe per lot. A lot shall be defined as pipe having the same identification marking. The length of specimen for each selected pipe shall be a minimum of 8-feet.

5. Pipe Retest: Pipe which is not installed within 120 days of the latest test shall not be used without prior approval of the District Representative.

6. Fitting and Coupling End Configurations: The socket and spigot configurations for fittings and couplings shall be compatible with those used for the pipe.

7. Manufacturers: Pipe shall be manufactured by Certainteed Corporation, J-M Manufacturing Company, Inc. and PW Eagle, Inc. (dba JM Eagle™), Vinyltech Corporation, Diamond Plastics Corporation, Westlake Pipe & Fittings or for contracts between District and Contractor, approved equal.

   Fittings shall be manufactured by GPK Products, Inc., Harco Fittings, Inc. (dba Harrington Corporation and HARCO), J-M Manufacturing Company, Inc. and PW Eagle, Inc. (dba JM Eagle™), Multi Fittings Corporation, Westlake Pipe & Fittings, Industrias Vasallo, Inc. (dba Vasallo Industries), or for contracts between District and Contractor, approved equal.

## B. Gaskets for PVC Pipe

1. General: Unless otherwise specified, gaskets shall be manufactured from a synthetic elastomer, and shall be extruded or molded and cured in such a manner as to be dense, homogeneous and of smooth surface, free of pitting, blisters, porosity, and other imperfections. The compound shall contain not less than 50 percent by volume of first-grade synthetic rubber. The remainder of the compound shall consist of pulverized fillers free of rubber substitutes, reclaimed rubber, and deleterious substances.

   The tolerance for any diameter measured at any cross section shall be $\pm$1/32-inch (0.8mm).

2. Gasket Material Requirements: When required by the District Representative, the Contractor shall furnish test samples of gaskets from each batch used in the work.

Gasket material shall meet the following requirements:

| **Property** | **Value** | **ASTM Test Method** |
|---|---|---|
| Tensile strength (min. psi) | 2,000 | D 412 |
| Elongation at break (% min.) | 350 | D 412 |
| Shore durometer, Type A (Pipe manufacturer shall select value suitable for type of joint) | 40 to 65* | D 2240 |
| Compression set (constant deflection) max. % of original deflection | 16 | D 395 Method B |
| Tensile strength after oven aging [96 hours, 158ºF (70ºC)] % of tensile strength before aging | 80 | D 573 |
| Increase in Shore durometer hardness after oven aging. Maximum increase over original Shore durometer | 10 | D 2240 |
| Physical requirements after exposure to ozone concentration [150 ppm. 70 hours, 140ºF (40ºC), 20% strain] | No cracks | D 1149 |

* This applies only to the sealing component of the gasket.

3. Splices: No more than one splice will be permitted in a gasket. A splice shall be made by applying suitable cement to the ends and vulcanizing the splice in a full mold. The splice shall show no separation when subjected to the following tests:

   a. Elongation Test: The part of the gasket which includes the splice shall withstand 100% elongation with no visible separation of the splice. While in the stretched position, the gasket shall be rotated in the spliced area minimum of 180 degrees in each direction in order to inspect for separation.

   b. Bend Test: The portion of the unstretched gasket containing the splice shall be wrapped a minimum of 180 degrees and a maximum of 270 degrees around a rod of a diameter equal to the cross section diameter of the gasket.

## PART 3 - EXECUTION

### A. Related Installation Specification

PVC gravity sewer pipe shall be installed in accordance with the applicable requirements of Section 02701, Installation of Gravity Sewer Pipelines and Section 02710, Vitrified Clay Pipe.

### B. Allowable Horizontal Curve Construction

Construction of curved reaches of PVC pipe may be accomplished by deflecting joints. Pipe deflection to achieve horizontal curves shall be limited by the manufacturer's maximum recommended limit or as follows, whichever provides the largest radius and the least deflection:

| Pipe Size (inches) | Minimum Radius (feet) |
|---|---|
| 6 | 210 |
| 8 | 280 |
| 10 | 350 |
| 12 | 420 |

**END OF SECTION**

# SECTION 03100

# CONCRETE FORMWORK

## PART 1 - GENERAL

### A. Description

This section describes materials and installation of concrete forms.

### B. Related Specification Sections

1. Concrete Reinforcement: 03201
2. Concrete Joints and Waterstops: 03260
3. Concrete: 03300
4. Concrete Finishing and Curing: 03345
5. Painting and Coating: 09900

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300 and the following.
2. Submit manufacturer's literature for form ties, spreaders, corner form, form coating, and bond breakers.

## PART 2 - MATERIALS

### A. Form Construction and Design

1. General: Forms shall be designed according to the applicable portions of ACI 347, "Recommended Practice for Concrete Formwork," and all applicable regulations and codes. All concrete shall be formed unless specified otherwise.
2. Observation Points: Form windows or stage forms shall be provided to allow observation at all times before concrete is poured. Formwork and placement design shall be such as to limit free fall of concrete to 4 feet.

3. Notification: The District's Representative shall be notified a minimum of one day prior to concrete placement.

**B. Classes of Forms**

1. Class I Forms: Smooth-surface plywood ¾-inch minimum thickness shall be used for straight surfaces and ½-inch minimum thickness for curved surfaces.

2. Class II Forms: Forms shall be made of plywood in good condition, metal, or smooth-planed boards free from large or loose knots with tongue and groove or ship lap joints. Forms shall be oiled.

3. Application: Class II forms shall be used for exterior concrete surfaces which are 1 foot or more below finished grade. Class I forms shall be used for all other surfaces.

**C. Form Material**

1. General: Forms shall be made of plywood, lumber, or steel of sufficient strength and surface smoothness to produce the specified finish. Joints, gaps, and apertures in forms shall be taped, gasketed, plugged and/or caulked so that the joint will remain watertight and withstand placing pressures without bulging outward or creating surface irregularities.

2. Lumber: Lumber used in form construction shall be standard grade Douglas fir, S4S Standard Grading and Dressing Rules No. 16, West Coast Lumber Inspection Bureau. Boards in contact with concrete shall be 6 inches or more in width.

3. Plywood: Plywood used in form construction shall be Grade B-B, Class 1 plyform, mill-oiled, and sanded on both sides in conformance with U.S. Product Standard PS-1.

**D. Form Ties**

1. General: Form ties shall be located on exposed surfaces in a uniform pattern or as indicated on the drawings. Form ties shall be constructed so that the tie remains embedded in the wall except for a removable portion at each end. Form ties shall have conical or spherical type inserts with a maximum diameter of 1 inch. Form ties shall be constructed so that no metal is within 1 inch of the concrete surface when the forms, inserts, and tie ends are removed. Wire ties shall not be used. Ties shall withstand all pressures and limit deflection of forms to acceptable limits.

2. Flat Bar Ties: Flat bar ties for panel forms shall have plastic or rubber inserts having a minimum depth of 1-inch and sufficient dimensions to permit patching of the tie hole.

3. Ties with Integral Waterstops: Ties for water-holding structures or dry structures with access, such as basement access shafts or pipe galleries that are below finish grade, shall have an integral steel waterstop that is tightly and continuously welded to the tie. The waterstop shall be at least two times larger in area than the tie cross-sectional area and shall be oriented perpendicular to the tie and symmetrical about the center of the tie. Ties shall be constructed to provide a positive means of preventing rotation or disturbance of the center portion of the tie during removal of the ends.

4. Tapered Form Ties: Tapered form ties shall be tapered through-bolts at least 1 inch in diameter at smallest end, or through-bolts that utilize a removable tapered sleeve of the same minimum size.

## E. Bond Breaker

Bond breaker shall be a nonstaining type which will provide a positive bond prevention, such as Williams Tilt-Up Compound, as manufactured by Williams Distributors, Inc., Seattle, Washington; Silcoseal 77, as manufactured by SCA Construction Supply Division, Superior Concrete Accessories, Franklin Park, Illinois; or approved equal.

## F. Form Release Agent

Form release agent shall effectively prevent absorption of moisture and prevent bond with the concrete. Agent shall be nonstaining and nontoxic after 30 days.

For steel forms, release agent shall prevent discoloration of the concrete due to rust.

# PART 3 - EXECUTION

## A. Form Tolerances

1. Rejected Work: Failure of the forms to produce the specified concrete surface and surface tolerance shall be grounds for rejection of the concrete work. Rejected work shall be repaired or replaced at no additional cost to the District.

2. Allowable Tolerances: The following table indicates tolerances or allowable variations from dimensions or positions of structural concrete work:

| | Maximum Tolerance |
|---|---|
| Sleeves and inserts | 1/4" ..... - 1/4" |
| Projected ends of anchors | 1/4" ..... - 0.0" |
| Anchor bolt setting | 1/4" ..... - 1/4" |
| Finished concrete, all locations | 1/4" ..... - 1/4", 10 feet |
| Finished concrete, total length | +1" |

The planes or axes from which the above tolerances are to be measured shall be as follows:

Sleeves and inserts: Centerline of sleeve or insert.

Projected ends of anchors: Plane perpendicular to the end of the anchor as located on the drawings.

Anchor bolt setting: Centerline of anchor bolt.

Finish concrete: The concrete surface as located on the drawings.

Where equipment is to be installed, the manufacturer's tolerances shall be complied with if more stringent than the above.

## B. Form Surface Preparation

1. Cleaning: Form surfaces to be in contact with the concrete shall be cleaned of all previous concrete, dirt, and other surface contaminants prior to preparation by the applicable method below.

2. Release Agent: Wood surfaces and steel surfaces in contact with the concrete shall be coated with a release agent prior to form installation. Release agent shall be submitted to and approved by the District prior to construction. For water storage facilities, a non-hazardous mineral oil type release agent shall be used.

## C. Chamfers

1. General Dimensions: 3/4-inch bevels shall be formed at concrete edges except those on top of walls and elevated slabs and beams. Edges at top of walls, slabs, and beams shall be rounded to a 3/4-inch radius.

2. Exterior Corners: Exterior corners in concrete members shall be provided with 3/4-inch chamfers. Reentrant corners in concrete members shall not have fillets, unless otherwise shown on the drawings.

## D. Form Placement

1. General: Forms shall be provided with adequate means for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. The forms shall be tight and braced in order to prevent movement and the loss of mortar and fines during placing and vibration of the concrete.

2. Inspection Openings: Cleanout and inspection openings shall be provided at the bottom of each lift of forms. There shall be one 12-inch-wide by 18-inch-high opening every 7 feet at the bottom of each lift of forms.

3. Allowable Embedment of Form Tie in Concrete: No part of any form-tying device other than metal shall be embedded in the concrete.

4. Taper Tie Orientation: The large end of taper ties shall be located on the "wet" side of the wall.

5. Prevention of Spalling: Only form or form-tying methods which do not cause spalling of the concrete upon form stripping or tie removal shall be allowed.

6. Non-formed Concrete: Surfaces of concrete members shall be formed except where placement of the concrete against the ground is shown on the drawings. The dimensions of concrete members shown on the drawings shall apply to formed surfaces, except where otherwise indicated. At least 2 inches of concrete shall be added where concrete is placed against trimmed undisturbed ground in lieu of forms. Placement of concrete against the ground shall be limited to footings and only where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing.

## E. Form Reuse

Only forms which maintain a uniform surface texture on exposed concrete surfaces shall be used. Light sanding shall be applied between uses to obtain uniform texture. Unused tie rod holes with corks, shaved flush, and sandpapered on the concrete surface side. Other than filling tie rod holes, forms shall not be patched except in the case of Class II forms. Metal patching discs shall not be used on Class I forms.

## F. Form Removal and Timing

1. Protection of Concrete Surfaces: Means shall be provided for removing forms without injury to the surface of the finished concrete.

2. Form Placement Duration: Forms and shoring for elevated structural slabs or beams shall remain in place until the concrete has reached a compressive strength equal to the specified 28-day compressive strength as determined by test cylinders. Supports shall not be removed and reshored. The following table indicates the minimum allowable time after the last cast concrete is placed before forms, shoring, or wall bracing shall be removed:

| | |
|---|---|
| Sides of footings and encasements | 24 hours |
| Walls not supporting load | 48 hours |
| Vertical sides of beams, girders, and similar members | 48 hours |
| Slabs, beams, and girders | 10 days (forms only) |
| Shoring for slab, beams, and girders | Until concrete strength reaches specified 28-day strength |
| Wall bracing | Until top or roof slab concrete reaches 2,500 psi |

3. Form Placement Duration in Cold Weather: Forms shall not be removed from concrete which has been placed with outside air temperature below 50° F without first determining if the concrete has properly set without regard for time. Heavy loading shall not be applied to green concrete. Immediately after forms are removed, the surface of the concrete shall be carefully examined and any irregularities in the surface shall be repaired and finished as specified.

## G. Formed Openings

Openings shall be of sufficient size to permit final alignment of the items within it without deflection or offsets of any kind and to allow space for packing where the items pass through the wall to ensure watertightness around openings so formed. Openings shall be provided with continuous keyways with waterstops where required, and a slight flare to facilitate grouting and the escape of entrained air during grouting. Formed openings shall be provided with reinforcement as indicated in the typical structural details. Reinforcing shall be at least 2-inches clear from the opening.

## H. Embedded Items

Anchor bolts and other embedded items shall be set accurately and held securely in position in the forms until the concrete is placed and set. All special castings, channels, or other metal parts that are to be embedded in the concrete shall be checked prior to and again after concreting. All nailing blocks, plugs, and strips necessary for the attachment of trim, finish, and similar work shall be checked prior to concreting.

## I. Pipes and Wall Spools Cast in Concrete

1. Fittings Cast in Formed Concrete Structures: Wall spools, wall flanges, and wall anchors shall be installed before placing concrete. Wall spools or anchors shall not be welded, tied, or otherwise connected to the reinforcing steel.

2. Pipe Encasement: Pipe and fabricated fittings to be encased in concrete shall be supported on concrete piers or pedestals. Concrete supports shall be carried to firm foundations so that no settlement occurs during construction. Concrete encasements shall be a minimum of 6" thick on all sides of the pipe.

**END OF SECTION**

# SECTION 03201

# CONCRETE REINFORCEMENT

## PART 1 - GENERAL

### A. Description

This section describes materials, testing, and installation of reinforcing steel for concrete.

### B. Related Work Specified Elsewhere

1. Concrete Formwork: 03100

2. Concrete: 03300

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300 and the following.

2. Submit mill test certificates identifying chemical and physical analyses of each load of reinforcing steel delivered. If mill test reports are unavailable and the quantity of steel for a structure exceeds 5 tons, then provide a laboratory test to prove yield strength and bending.

3. Submit bending lists and placing drawings for all reinforcing steel. Each bending list submitted shall be complete, including corner bars as required. Furnishing such lists shall not be construed that the lists will be reviewed for accuracy. The Contractor shall be wholly and completely responsible for the accuracy of the lists and for furnishing and placing reinforcing steel in accordance with the details shown on the plans and as may be specified elsewhere in the contract documents.

## PART 2 - MATERIALS

### A. Reinforcing Steel

1. General Requirements: Reinforcing steel shall be new material conforming to ASTM A 615, Grade 60, and 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 bent while cold.

2. Delivery: Reinforcing steel shall be delivered to the site bundled and with identifying tags.

**B. Welded Wire Fabric**

Welded wire fabric shall conform to ASTM A 185. The minimum gauge of the welded wire fabric shall be 6 x 6 – W1.4 x W1.4. The welded wire fabric shall be determined by the Engineer and approved by the District.

**C. Tie Wire**

Tie wire shall be 16 gage minimum, black, soft annealed.

**D. 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 in concrete placed on grade.

## PART 3 - EXECUTION

**A. Placing**

1. General: Reinforcing steel shall be placed in accordance with ACI and the current edition of Recommended Practice for Placing Reinforcing Bars, published by the Concrete Reinforcing Steel Institute.

2. Cleaning: Reinforcing steel, before being positioned, shall be free from loose mill and rust scale and from any coatings that may destroy or reduce the bond. Where there is delay in depositing concrete, reinforcement steel shall be cleaned by abrasive sandblasting to remove mortar, oil, dirt, excessive mill scale, scabby rust, and coatings of any character that would destroy or reduce the bonding capability.

3. Bending: Reinforcing steel shall not be straightened or reshaped in a manner that will injure the material. Bars with bends not shown on the drawings shall not be used.

4. Reinforcing Steel Positioning: Reinforcing steel shall be positioned in accordance with the drawings and secured by using annealed wire ties or clips at inter-sections and support by concrete or metal supports, spacers, or metal hangers. Metal clips or supports shall not come in contact with the forms. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage. Bars in addition to those shown on the drawings, which may be found

necessary or desirable for the purpose of securing reinforcement in position, may be provided, at no additional expense to the District.

5. Clearance and Cover: Reinforcing steel shall be placed a minimum of 2 inches clear of any metal pipe or fittings. Unless otherwise indicated on the Plans, reinforcement shall be placed so as to provide the thickness of protective concrete covering as indicated on the Typical Details. If not indicated on the Plans or Standard Drawings, protective covering shall be in accordance with ACI 318.

**B. Splices**

Unless otherwise shown, splices in adjacent horizontal bars shall be staggered 48 bar diameters.

**END OF SECTION**

# SECTION 03260

# CONCRETE JOINTS AND WATERSTOPS

## PART 1 - GENERAL

### A. Description

This section describes materials, testing, and installation of construction and expansion joints, PVC waterstops, premolded joint filler, joint sealant, and bond breaker tape.

### B. Related Work Specified Elsewhere

1. Concrete Formwork: 03100

2. Concrete Reinforcement: 03201

3. Concrete: 03300

4. Concrete Finishing and Curing: 03345

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300 and the following.

2. Submit manufacturer's literature, catalog data, and statement of compliance with referenced standards and specifications.

3. Submit material samples of PVC waterstops.

## PART 2 - MATERIALS

### A. PVC Waterstop

1. Material: Waterstops shall be extruded from a PVC compound and shall be flat-strip ribbed type as manufactured by B. F. Goodrich Company, Kirkhill Rubber Company, or approved equal. Waterstop shall comply with Corps of Engineers Specification CRD-C-572. The basic resin of the material shall be a PVC resin plastic, containing nonmigrating-type plasticizers, and shall not be appreciably affected by alkali, acids, or saltwater. All material shall be virgin material; the use of reworked PVC or approved other substitute will not be permitted.

2. Fittings: Waterstops shall be supplied and installed in accord with the dimensions shown on the drawings, and shall be made continuous by means of factory made fittings.

## B. Joint Sealant for Concrete Structures

The joint sealant shall be a two-part, gray, nonstaining, nonsagging, polyurethane sealant, which cures at ambient temperature to a firm, flexible, tear-resistant rubber. The sealer shall be resilient and have excellent recovery characteristics after extended periods of compression or elongation. Sealant shall be PRC 270, Vulkem 227, or approved equal.

Technical Requirements:

| | |
|---|---|
| Consistency | Gun grade |
| Tack free time | 24 hours at 75°F and 50% R.H. |
| Pot life | 1 to 3 hours |
| Hardness | 30 Shore A, +/-5 |
| Elongation | 750% |
| Tensile Strength, ASTM D 412 | 325 psi |
| Peel strength on concrete | 18 psi cohesive |
| Temperature service range | -40°F to +175°F |
| Immersion in water | Continuous |

## C. Neoprene Rods for Precast Slab Joints

Neoprene rods shall be of the indicated diameter, 50 durometer.

## D. Premolded Joint Filler

Joint filler shall be preformed, nonextruded type, constructed of closed-cell neoprene conforming to ASTM D 1752, Type I, as manufactured by W. R. Grace Company of Cambridge, Massachusetts; W. R. Meadows, Inc., Elgin, Illinois; or approved equal.

## E. Neoprene Bearing Pads

Neoprene bearing pads for precast concrete slabs shall be of the indicated size, thickness, and length, 60 durometer.

## F. Bond Breaker Tape

Bond breaker tape shall be an adhesive backed glazed butyl or polyethylene which will adhere to the premolded joint material or concrete surface. The tape shall be the same width as the joint. The tape shall be compatible with the sealant.

## PART 3 - EXECUTION

### A. PVC Waterstops

1. Installation: Waterstops shall be installed in construction and expansion joints in hydraulic structures or where shown on the drawings. Forms for construction joints shall be constructed in such a manner as to prevent damage to waterstops. Waterstops shall be held securely in position in the construction joints by wire ties, continuous bars, and rings as indicated. Waterstops shall be properly heat spliced at ends and intersections to ensure continuity.

2. Field Splices: Field splices shall be made with a thermostatically controlled heating iron in conformance with the manufacturer's recommendations. At least 10 minutes shall be allowed before pulling or straining the new splice in any way. The finished splices shall provide a cross section that is dense and free of porosity with tensile strength of not less than 80% of the unspliced materials.

### B. Construction Joints

1. General: Construction joints shall be provided where shown on the drawings. In case of emergency, additional construction joints shall be placed. An interval of 45 minutes between two consecutive batches of concrete shall constitute cause for an emergency construction joint. All emergency construction joints are subject to final approval by the District.

2. Construction Joint Keyways: Construction joints shall be keyed, if indicated on the drawings. Keyways shall be formed by beveled strips or boards placed at right angles to the direction of shear. Except where otherwise shown on the drawings or specified, keyways shall be at least 1-1/2 inches in depth over at least 25% of the area of the section.

3. Reinforcing Dowels: When an emergency joint is necessary, the joint shall be keyed and reinforcing dowels shall be furnished and placed across the joint. These dowels shall be embedded 60 bar diameters into each side of the joint. Size and number of dowels shall match reinforcing in the member. Furnishing and placing such reinforcing steel shall be done at no additional expense to the District.

4. Joint Preparation for Adjacent Pour: After the pour has been completed to the construction joint and the concrete has hardened, the entire surface of the joint shall be thoroughly cleaned of surface laitance, loose or defective concrete, and foreign material, and clean aggregate shall be exposed by sandblasting the surface of construction joints before placing the new concrete. Horizontal

construction joints shall be covered with mortar. Mortar shall be spread uniformly and worked thoroughly into all irregularities of the surface. The mortar shall be flowable and shall consist of sand, water, and a minimum of 12 sacks of cement per cubic yard. A positive measuring device, such as a bucket, or other device shall be provided that will contain only enough mortar for depositing in one place in the wall or column to ensure that portion of the form does not receive too much mortar. Mortar shall not be deposited from pump hoses or large concrete buckets unless inspection windows close to the joint are available to allow visual measurement of mortar thickness and means for mortar removal is available for removal of any excess. The water-cement ratio of the mortar in place shall not exceed that of the concrete to be placed upon it. The consistency of the mortar shall be suitable for placing and working.

## C. Installation of Premolded Joint Filler

Premolded joint filler shall be installed in joints accurately as shown. Joint filler shall be attached to concrete with a bonding agent recommended by the joint sealant and joint filler manufacturer for compatibility.

## D. Installation of Joint Sealants

1. Joint Cavity Preparation: Immediately before installing the joint sealant, the joint cavity shall be cleaned by sandblasting or power wire brushing. Bond breaker tape shall be installed per manufacturer's instructions.

2. Sealant Application: After the joints have been prepared as described above, the joint sealant shall be applied. Primer, if required, and joint sealant shall be applied only with the equipment and methods recommended by the joint sealant manufacturer. Application criteria for the sealant materials, such as temperature and moisture requirements and primer cure time, shall be in accordance with the recommendations of the sealant manufacturer.

3. Finishing: Masking tape shall be applied along the edges of the exposed surface of the exposed joints. Joints shall be troweled smooth with a tuck pointing tool wiped with a solvent as recommended by the sealant manufacturer.

4. Cleanup: After the sealant has been applied, masking tape and any sealant spillage shall be removed.

## E. Installation of Neoprene Rods in Precast Slab Joints

Neoprene rods shall be forced down to the bottom of the shaped joint prior to placing drypack in the joint.

## F. Installation of Neoprene Bearing Pads

Neoprene bearing pads shall be placed in the indicated position on the concrete walls and glued to the wall with suitable adhesive.

**END OF SECTION**

# SECTION 03300

# CONCRETE

## PART 1 - GENERAL

### A. Description

This section describes materials, mixing, and placing of concrete and grout.

### B. Related Work Specified Elsewhere

1. Concrete Formwork: 03100

2. Concrete Reinforcement: 03201

3. Concrete Joints and Waterstops: 03260

4. Concrete Finishing and Curing: 03345

5. Standard Specifications for Public Works Construction

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300, ACI 318, and the following.

2. Mix design with proof of design by laboratory 7-day and 28-day compressive tests, or test reports of 7-day and 28-day compressive tests of the mix where the same mix was used on two previous projects, shall be submitted in writing for review by the District at least 15 days before placing of any concrete.

3. Certificate that cement used in the concrete complies with ASTM C 150 and these specifications shall be submitted to the District.

4. Aggregates: Certificate of compliance with ASTM C 33 shall be provided. Weathering region limits of coarse aggregates: severe, moderate, or negligible shall be stated. Basis of determining that potential reactivity is negligible shall be stated.

5. Ready Mix Concrete: Delivery tickets or weighmasters certificate per ASTM C 94, including weights of cement and each size aggregate, volume of water in the aggregate, and volume of water added at the plant shall be provided. The volume of water added on the job shall be written on the ticket or certificate.

6. Concrete admixtures: Manufacturer's certificate of compliance with these specifications shall be provided.

7. Epoxy Bonding Compound: Manufacturer's specific instructions for use shall be provided.

8. Nonshrink Grout: Manufacturer's certificate of compliance with these specifications and specific instructions for use shall be provided.

## PART 2 - MATERIALS

### A. Cement

Cement shall conform to ASTM C 150, Type II or Type V, with maximum tricalcium aluminate not to exceed 6%. The maximum percent alkalies shall not exceed 0.6%.

### B. Aggregates

Aggregates shall comply with ASTM C 33 and shall be free from any substances that will react with the cement alkalies.

### C. Water and Ice

Water and ice that is clean and free from objectionable quantities of organic matter, alkali, salts, and any other impurities which might reduce the strength, durability, and quality of the concrete shall be used in the concrete mix.

### D. Color Additive

For exterior electrical duct concrete encasements, a color additive shall be used for identification purposes: Color additive shall be: brick red "Colorfull," as manufactured by Owl Manufacturing Company, Arcadia, California; coral red "Chromix C-22," as manufactured by L. M. Scofield Company, Los Angeles, California; or approved equal. The color additive shall be added while the concrete is being mixed using the quantity per cubic yard of concrete recommended by the manufacturer for the class of concrete indicated.

### E. Concrete Admixtures

1. Air Entraining Admixture: Concrete may contain an air-entraining admixture which shall conform to ASTM C 260, except it shall be nontoxic after 30 days and shall contain no chlorides. Admixture shall be Master Builders MB-VR, Sika AER (Sikamix 104), or approved equal.

2. Water Reduction Admixture: Concrete may contain a water-reducing admixture which shall conform to ASTM C 494, Type A or Type D, except it shall contain no chlorides, shall be nontoxic after 30 days, and shall be compatible with the air-entraining admixture. The amount of admixture added to the concrete shall be in accordance with the manufacturer's recommendations. Admixture shall be Master Builders Pozzolith polymer-type normal setting, Plastocrete (Sikamix 160) Normal Set, Sika Chemical Corporation, or approved equal.

3. Restrictions: Accelerating water-reducing admixtures or any other type of admixture that contains chlorides or other corrosive elements shall not be used in any concrete.

## F. Nonshrink Grout

Nonshrink grout shall conform to the Corps of Engineers Specification for Nonshrink Grout, CRD-C588-78, and to these specifications. Use a non gas-liberating type, cement base, premixed product requiring only the addition of water for the required consistency. Grout shall be UPCON High Flow, Master Flow 713, or approved equal. All components shall be inorganic.

## G. Ordinary Type Grout (Dry Pack)

Ordinary type grout shall consist of one part portland cement to two parts sand (100% passing a No. 8 sieve). Sufficient water shall be added to produce damp formable consistency.

## H. Epoxy Bonding Compound

Manufacturer's certifications as to suitability of product to meet job requirements with regard to surface, pot life, set time, vertical or horizontal application, and forming restrictions shall be provided. Bonding compound shall be Concresive 1001 LPL, Adhesive Engineering Company, San Carlos, California; Sikadur Hi-Mod (Sikastix 370), Sika Chemical Corporation, Lyndhurst, New Jersey; or approved equal.

## I. Concrete Mix Design

1. General: Concrete mix design shall conform to ASTM C 94 and ACI 318, except as modified by these specifications.

2. Fly Ash: Fly ash shall not be used in the mix as a partial substitute for cement.

3. Air Content: Air content as determined by ASTM C 231 shall be 4% +/-1%.

4. Water-Cement Ratio: Maximum water-cement ratio for Class A concrete shall not exceed 0.44 by weight.

5. Classes: Classes of concrete shall be used as described in the following table:

| Class | Type of Work | Minimum 28-Day Compressive Strength (psi) | Minimum Cement Content (lbs per C.Y.) |
|---|---|---|---|
| A | Structures (all)<br>Curbings<br>Sidewalks<br>Slope anchors<br>Unspecified by Plans | 3,250 | 564 = 6 sk. |
| B | Thrust restraint and anchor blocks, where shown on plans or YLWD std. drawings | 2,500 | 470 = 5 sk |
| C | Fill for structure foundations, cradles, supports across pipe trenches, and miscellaneous unreinforced concrete | 2,000 | 376 = 4 sk |
| C | Manhole base | 3,250 | 560 = 5.96 sk |

6. Slump: Slump shall be measured in accordance with ASTM C 143. Slump shall be as follows:

| | |
|---|---|
| Slab on grade or heavy sections wider (in plan view) than 3 feet | 3 inches maximum |
| Footings, walls, suspended slabs, beams, manhole base, and columns | 4 inches maximum |

Concrete shall be proportioned and produced to have a maximum slump as shown. A tolerance of up to 1 inch above the indicated maximum shall be allowed for individual batches provided the average for all batches or the most recent 10 batches tested, whichever is fewer, does not exceed the maximum limit. Concrete of lower than usual slump may be used provided it is properly placed and consolidated.

7. Aggregate Size: Aggregate size shall be ¾-inch maximum for slabs and sections 8 inches thick and less. Aggregate size shall be 1½ inches maximum for all larger slabs and sections. Combined aggregate grading shall be as shown in the following table:

| Maximum Aggregate Size – Percentage Passing | | |
|---|---|---|
| **Sieve Sizes** | **1-1/2”** | **3/4”** |
| 2” | 100 | -- |
| 1-1/2” | 90 – 100 | -- |
| 1” | 50 – 86 | 100 |
| 3/4” | 45 – 75 | 90 – 100 |
| 3/8” | 38 – 55 | 60 – 80 |
| No. 4 | 30 – 45 | 40 – 60 |
| No. 8 | 23 – 38 | 30 – 45 |
| No. 16 | 17 – 33 | 20 – 35 |
| No. 30 | 10 – 22 | 13 – 23 |
| No. 50 | 4 – 10 | 5 – 15 |
| No. 100 | 1 – 3 | 0 – 5 |
| No. 200 | 0 – 2 | 0 – 2 |

8. Pumped Concrete Design Mix: Mix design for pumped concrete shall produce a plastic and workable mix. The percentage of sand in the mix shall be based on the void volume of the coarse aggregate.

## J. Workability

1. General: Concrete shall be of such consistency and composition that it can be worked readily into the forms and around the reinforcement without excessive spading and without permitting the materials to segregate or free water to collect on the surface. The proportions shall be adjusted to secure a plastic, cohesive mixture, and one which is within the specified slump range.

2. Aggregate: To avoid unnecessary changes in consistency, aggregate shall be obtained from a source with uniform quality, moisture content, and grading. Materials shall be handled in such a manner that variations in moisture content will not interfere with production of concrete of the specified degree of uniformity and slump.

# PART 3 - EXECUTION

## A. Site-Mixed Concrete

1. General: Site-mixed concrete shall conform to ACI 304 as modified by these specifications.

2. Batching and Mixing Equipment: A batch-type mixer shall be used that is capable of combining the aggregates, cement, and water within the specified time into a thoroughly mixed and uniform mass and discharging the mixture without segregation. Supporting equipment shall be used that can accurately

proportion the cement, the coarse and fine aggregates, the admixtures, and the water which enters the mixing drum. Cement and aggregate shall be proportioned by weight. Each entire batch shall be discharged before recharging. The volume of the mixed materials per batch shall not be allowed to exceed the manufacturer's rated capacity of the mixer.

3. Mixing Time: Mixing time shall be as follows:

   a. For mixer of a capacity of 1 cubic yard or less, one and one-half minutes after batching is completed.

   b. For mixers of capacities larger than 1 cubic yard, one and one-half minutes plus one-half minute for each additional 1/2-cubic-yard capacity or fraction thereof in excess of 1 cubic yard.

   c. The mixer shall revolve at a uniform rate as specified by the manufacturer for the mixing equipment.

**B. Ready-Mixed Concrete**

1. General: Ready-mixed concrete shall conform to ASTM C 94 as modified by these specifications.

2. Ready-mixed concrete shall be delivered to the site, and discharge shall be completed within 90 minutes after the addition of the cement to the aggregates.

**C. Placing Concrete**

1. General: Concrete placement shall conform to ACI 304 as modified by these specifications.

2. Placement Sequence: The sequence of concrete placement shall be coordinated in advance of actual placement to assure that construction joints will occur only as designed. The District's Representative shall be furnished a copy of the sequence of placement in advance of actual placement. Alternate sections of concrete walls and slabs shall be placed monolithically. Concrete for walls and slabs shall not be placed until seven days after placement of concrete for adjacent walls and slabs.

3. Notification: The District's Representative shall be notified of readiness, not just intention, to place concrete in any portion of the work. This notification shall be such time in advance of the operation as the District's Representative deems necessary for him to observe the preparations at the location of the proposed concrete placing. All forms, steel, screeds, anchors, ties, inserts and

other items to be embedded shall be in place before notification of readiness is given to the District's Representative.

4. Equipment Readiness: Sufficient primary and backup equipment shall be scheduled for continuous concrete placement, and anticipate what actions will be taken during interruption. Extra concrete vibrators shall be provided. Concrete vibrators shall be tested the day before placing concrete.

5. Removal of Water from Areas to Receive Concrete: Concrete shall not be placed until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes or other means and carried out of the forms, clear of the work. Concrete shall not be placed underwater, nor shall still water be allowed to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the newly deposited concrete in such manner and of such velocity that will damage the surface finish.

6. Moisture Barriers: Where a moisture barrier is installed, the moisture barrier shall not be punctured by stakes or any other concrete accessories.

7. Concrete Pours and Freefall: Concrete shall be deposited at or near its final position to avoid segregation caused by rehandling or flowing. Concrete shall not be deposited in large quantities in one place to be worked along the forms with a vibrator. Concrete shall not be dropped freely into place from a height greater than 4 feet. Tremies shall be used where the drop could exceed these limits.

8. Consolidation of Concrete: Mechanical vibrators shall be used while placing concrete to eliminate rock pockets and voids, to consolidate each layer with that previously placed, to completely embed reinforcing bars and fixtures, and to bring just enough fine material to exposed surfaces to produce a smooth, dense, and even texture. Vibrators shall be of the high-frequency internal type, and the number in use shall be able to consolidate the incoming concrete to a proper degree within 15 minutes after it is deposited in the forms. In all cases, at least two vibrators shall be available at the site. External vibrators shall be used for consolidating concrete only when the concrete is otherwise inaccessible for adequate internal consolidating.

9. Protection of Concrete: Concrete shall not be placed during wet weather events. Concrete placed immediately before rain shall be protected to prevent rainwater from coming in contact with it. Sufficient protective covering shall be kept on hand at all times for this purpose.

**D. Concrete Tests (For Contracts between the District and Contractor)**

1. General: Strength tests shall be performed on the concrete by the District's Representative as follows:

   a. Mold and cure three concrete test cylinders from each 50 cubic yards, or fraction thereof, of each class of concrete placed in any one day. Mold and cure the cylinders in accordance with ASTM C 31.

   b. Test cylinders in accordance with ASTM C 39. Test two cylinders at 28 days for acceptance, and test one at 7 days for information. The test results shall be the average of the strengths of the two cylinders tested at 28 days. If one cylinder in a test manifests evidence of improper sampling, molding, or testing, other than low strength, discard it and use the strength of the remaining cylinder for the test result. Should both cylinders in a test show any of the above defects, discard the entire test.

   c. Determine slump of the concrete using ASTM C 143 for each strength test sample and as required to establish consistency.

   d. Determine air content of the concrete using ASTM C 231 for each strength test sample and as required to establish consistency.

2. Notification and Handling of Samples: To facilitate testing and inspection:

   a. The District shall be advised in advance of concrete placing operations to allow for completion of quality tests.

   b. Labor necessary to assist the District Representative in obtaining and handling samples at the project shall be furnished by the Contractor.

   c. Facilities for safe storage and proper curing of concrete test specimens on the project site, as required by ASTM C 31 shall be provided and maintained by the Contractor for the sole use of the District.

3. Requirements for Attainment of Compressive Strength: Concrete specified by compressive strength shall attain the 28-day strength specified in Part 2, Paragraph I of this section. The average of any three consecutive strength tests shall be equal to or greater than the specified 28-day strength. Not more than 10% of the tests shall be less than specified 28-day strength. No test shall be less than 85% of the specified 28-day strength.

4. Failure to Attain Specified Strength: If the 28-day tests fail to meet the specified minimum compressive strength, the concrete will be assumed to be

defective and one set of three cores from each area may be taken as selected by the District and in accordance with ASTM C 42. If the average compressive strength, of the set of three concrete cores fails to equal 85% of the specified minimum compressive strength or if any single core is less than 75% of the minimum compressive strength, the concrete will be considered defective and shall be removed and replaced, all at no cost to the District. Costs of coring, testing of cores, and all required repairing pertaining thereto shall be the responsibility of the Contractor.

## E. Pumping Concrete

1. Equipment Capacity Requirements: Pump size shall be determined by the rate of concrete placement, length of delivery pipe or hose, aggregate size, mix proportions, vertical lift, and slump of concrete.

   Minimum inside diameter of pipe or hose shall be based on the maximum aggregate size as follows:

   | | |
   |---|---|
   | 3/4-inch-max aggregate: | 2 inches min ID |
   | 1-1/2-inch-max aggregate: | 4 inches min ID |

2. Disallowance of Aluminum Pipe: Aluminum pipes shall not be used for delivery of concrete to the forms.

3. Priming: Before pumping is started, the delivery pipe or hose shall be primed by pumping mortar through the line using 5 gallons of mortar for each 50 feet of delivery line. Mortar shall be pumped to waste and not deposited in the forms.

## F. Hot Weather Requirements

1. General: During hot weather, proper attention shall be given to ingredients, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation in accordance with ACI 305 and the following. There shall be no additional reimbursement for costs incurred for placing concrete in hot weather.

2. Cooling Methods: When the weather is such that the temperature of the concrete as placed would exceed 90°F, ice or other effective means of cooling the concrete during mixing and transportation shall be used so that the temperature of the concrete as placed will not exceed 90°F.

3. Prevention Against Early Setting of Concrete: Precautions shall be taken when placing concrete during hot, dry weather to eliminate early setting of concrete. This includes protection of reinforcing from direct sunlight to prevent heating

of reinforcing, placing concrete during cooler hours of the day, and the proper and timely application of specified curing methods.

## G. Cold Weather Requirements

1. General: Adequate equipment shall be provided for heating concrete materials and protecting concrete during freezing or near-freezing weather in accordance with ACI 306 and the following. There shall be no additional reimbursement for costs incurred for placing concrete during cold weather.

2. Heated Mixing Water: When the temperature of the surrounding atmosphere is 40°F or is likely to fall below this temperature, the mixing water shall be heated to, but not exceed, 140°F. The heated water shall not be allowed to come in contact with the cement before the cement is added to the batch.

3. Temperature Requirements: When placed in the forms during cold weather, the concrete temperature shall be maintained at not less than 55°F. All materials shall be free from ice, snow, and frozen lumps before entering the mixer.

4. Curing Requirements: The air and the forms in contact with the concrete shall be maintained at temperatures above 40°F for the first five days after placing, and above 35°F for the remainder of the curing period. Thermometers shall be provided by the Contractor to indicate the ambient temperature and the temperature 2 inches inside the concrete surface.

## H. Bonding to Existing Concrete

Existing concrete to which new concrete is to be bonded shall have the contact surfaces coated with epoxy bonding compound. The method of preparation and application of the bonding compound shall conform to the manufacturer's printed instructions and recommendations for specific application for this project.

## I. Grouting Machinery Foundations

During placement of machinery, concrete shall be blocked out or finished off a sufficient distance below the bottom of the machinery base to provide for the thickness of grout shown on the drawings. After the machinery has been set in position and wedged to the proper elevation by steel wedges, the space between the bottom of the machinery base and the original pour of concrete shall be filled with a pourable nonshrink grout.

**END OF SECTION**

# SECTION 03345

# CONCRETE FINISHING AND CURING

## PART 1 - GENERAL

### A. Description

This section describes materials and methods of concrete finishes, curing, repair of defects, and surface protection.

### B. Related Work Specified Elsewhere:

1. Concrete Formwork: 03100

2. Concrete Reinforcement: 03201

3. Concrete Joints and Waterstops: 03260

4. Concrete: 03300

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300 and the following.

2. Curing Compound: Submit manufacturer's statement of compliance with these specifications and recommended coverage to meet or exceed the specified tests. Submit manufacturer's application instructions.

## PART 2 - MATERIALS

### A. Curing Compound

1. General: Curing compound shall conform to ASTM C 309, Type 2, Class B, and shall be compatible with required finishes and coatings.

2. Manufacturers: Curing compound shall be: Masterseal, manufactured by Master Builders, Cleveland, Ohio; Evco Floor Coat, manufactured by Euclid Chemical Co., Cleveland, Ohio; or approved equal.

## B. Mortar for Repair of Concrete

Mortar used for repair of concrete shall be made of the same materials as used for concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not more than one part cement to two and one-half parts sand by damp loose volume. The quantity of mixing water shall be no more than necessary for handling and placing.

# PART 3 - EXECUTION

## A. Concrete Finishes

Concrete surfaces shall be completed in accordance with the following schedule:

| Finish Designation | Applicable Surface |
|---|---|
| F-1 | Exterior walls exposed to water or groundwater, and interior of tank walls. |
| F-2 | Walls, structures, or building walls exposed to view. Underside of formed floors or slabs. |
| S-1 | Slabs and floors. |
| E-1 | Exposed edges of slabs, floors, and wall tops. |
| Finish F-1: | Defective concrete shall be repaired, fins removed, depressions 1/4 inch or deeper filled, and form-tie holes filled. |
| Finish F-2: | In addition to repairs of Finish F-1, depressions and air holes shall be opened by whip-blasting and filled with mortar. Surfaces shall be dampened and a slurry consisting of one part cement and one and one-half parts sand by damp loose volume shall be spread over the surface with clean burlap pads or sponge rubber floats. Any surplus shall be removed by scraping and then rubbing with clean burlap. |
| Finish S-1: | Shall be a medium broom finish. |
| Finish E-1: | Exposed edges of slabs, floors, and tops of walls, shall be finished with a 3/4-inch-radius edger, where chamfer is not indicated. |

## B. Finishing of Formed Surfaces

1. Curing Requirement: Surfaces shall be water cured until finishing and repairing are completed.

2. Repair of Surface Defects: Immediately after forms are removed, fins and irregularities shall be removed by grinding or rubbing. Depressions deeper than specified shall be filled with mortar, and form-tie holes filled.

3. Form-tie Holes: Form-tie holes shall be reamed with toothed reamers until surface of hole is rough and clean. Surface shall be coated with epoxy bonding compound and filled with mortar. Tapered form-tie holes shall be finished as follows:

   a. Form-tie holes shall be sandblasted and blown clean prior to filling.

   b. A rubber plug, with one end open, shall be driven to the center of the hole. Plug size shall be larger in diameter than the diameter of the hole at the center of the wall.

   c. The entire annular surface of the hole shall be coated with epoxy prior to filling with mortar. Epoxy shall be applied in accordance with manufacturer's instructions.

   d. Each side of hole shall be filled with mortar. Mortar shall be applied to the "wet" side of the wall first. Mortar shall be solidly consolidated into the hole.

   e. The District Representative shall be notified in advance of the form-tie hole filling schedule.

## C. Repair of Surface Defects

1. Repair Limits: Honeycombed and other defective concrete shall be removed down to sound concrete. Edges shall be perpendicular to surface. Surfaces to receive repair shall be sandblasted.

2. Bonding Compound: Sandblasted surface shall be coated with epoxy bonding compound.

3. Mortar Placement: Mortar shall be placed in layers having a compacted thickness of 3/8-inch. The surface of each layer shall be scratched to promote bonding with next layer. Finish repair shall match adjacent concrete and cure as specified.

4. Repair of Large Defective Areas: Defective areas of more than 1 foot square and deeper than the reinforcing steel shall be repaired as above, with the exception that the area shall be filled with pneumatically applied concrete.

## D. Curing

1. Allowable Curing Methods: Concrete surfaces shall be cured by water curing or by use of sprayed curing compound at the Contractor's option. Where wooden forms are used, the forms shall be wet immediately before concreting

and keep moist by sprinkling until removed. All exposed surfaces of formed concrete shall be kept moist until curing compound is applied.

2. Curing Compound Method:

   a. Concrete shall be cured for not less than 14 days after placement.

   b. The surface shall be sprayed with two coats of liquid curing compound. Curing compound shall be applied in accordance with the manufacturer's instructions to cover the surface with a uniform film which will seal thoroughly. A second coat shall be applied at 90 degrees to the direction of spray for the first coat.

   c. Curing compound shall be applied immediately after completion of the finish on unformed surfaces, and within two hours after removal of forms on formed surfaces. Formed surfaces shall be repaired within the said two-hour period; provided, however, that any such repairs which cannot be made within the said two-hour period shall be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing compound has been applied, the area shall first be sandblasted to remove the curing compound, then repaired.

   d. Wherever curing compound may have been applied to surfaces against which concrete subsequently is to be placed and to which it is to adhere, the curing compound shall be removed entirely by sandblasting prior to the placing of new concrete.

   e. Care shall be taken to avoid damaging the seal during the curing period. Damaged or broken seals shall be repaired immediately by the application of additional curing compound.

**END OF SECTION**

# SECTION 03461

# PRECAST REINFORCED CONCRETE MANHOLES AND MANHOLE BASES

## PART 1 - GENERAL

### A. Description

This section includes materials, testing, and installation of precast concrete manholes, manhole bases, manhole frames and covers, manhole locks and manhole lining.

### B. Related Work Specified Elsewhere

1. Structure Earthwork: 02200

2. Trenching, Backfilling, and Compacting: 02223

3. Concrete: 03300

4. Leakage and Infiltration Testing: 15043

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300.

2. Submit manufacturer's catalog and test data on precast concrete manholes, frames, and covers along with installation recommendations for inlet and outlet seals and watertight caulking. Show dimensions and materials of construction by ASTM reference and grade. Show manhole cover lettering and pattern.

## PART 2 - MATERIALS

### A. Precast Concrete Manholes

1. General: Precast reinforced concrete manholes shall comply with ASTM C 478, with a minimum wall thickness of 6-inches.

2. Design Load: Manhole components shall be designed for H-20 highway loads and site soil conditions.

3. Concrete: Precast reinforced concrete manhole risers and tops shall be constructed of Class A concrete with Type II or Type V cement per Section 03300, Concrete.

4. Manhole Section Configuration: Manholes shall be fabricated only from eccentric taper sections and standard cylinder units of the proper internal diameter. See Standard Drawing S-1.

5. Manhole Section Dimensions: Unless noted otherwise, minimum diameter and wall thickness of manholes and manhole sections shall be as follows:

| Depth of Cover, feet | Manhole Diameter, inches | Manhole Section Wall Thickness, inches |
|---|---|---|
| Less than 15 | 48 | 6 |
| 15 to 22 | 60 | 6 |
| Greater than 22 | 72 | 7 |

Depth of cover shall be measured from proposed finish surface elevation to the elevation of the top of the manhole base.

6. Steps: Manhole sections shall be cast without steps.

7. Drop Manholes: Drop manholes shall be constructed only at the locations shown on the drawings or where permission has been obtained from the District. Where approved for use in sewer lines of diameter 10-inches and smaller, drop manholes shall conform to Standard Drawing S-5.

8. Manufacturers: Precast reinforced concrete manholes shall be manufactured by Southwest Concrete Products (CalPortland), Oldcastle Precast, Precon Products, Olson Precast Company, Manhole Construction Specialists, Inc., or for contracts between District and Contractor, approved equal.

9. Warning Signs: The entrance to every manhole shall have a warning sign stenciled onto the wall of the uppermost circular shaft section, with the inscription: "DANGER – CONFINED SPACE. VENTILATE BEFORE ENTERING." in clear, 2-inch high lettering, as shown in Standard Drawing S-1.

## B. Manhole Frames and Covers

1. General Requirements: Frames, covers and locks shall be suitable for service in the collection system environment. Frames and covers shall be of the traffic type, designed for H-20 loading. See Standard Drawing S-4.

2. Fit and Matchmarking: Each manhole cover shall be ground or otherwise finished so that it will fit in its frame without rocking. Frames and covers shall be matchmarked in sets before shipping to the site.

3. Cover Inscription: Covers shall have "YLWD SEWER" cast thereon as shown in Standard Drawing No. S-4 or on the plans. No other lettering on the top side shall be permitted.

4. Material: Manhole frames and covers shall be made of ductile iron, cast iron, or fabricated of fiber reinforced polymer (FRP) and shall be suitable for service in the collection system environment.

a. Ductile Iron or Cast Iron

i. Manhole frames and covers made of ductile iron shall conform to ASTM A 536, Class 400. Cast iron shall conform to ASTM A 48, Class 30. Casting shall be smooth, clean, and free from blisters, blowholes, and shrinkage.

ii. Before leaving the foundry, castings shall be cleaned and subjected to a hammer inspection. Castings shall then be dipped twice in a preparation of asphalt or coal tar and oil applied at a temperature of not less than 290°F, not more than 310°F, and in such a manner as to form a firm and tenacious coating.

iii. Manhole frames and covers shall be manufactured by Neenah Foundry, Long Beach Iron Works, South Bay Foundry, Pont-A-Mousson, or equal.

b. Fiber reinforced polymer (FRP)

i. The frame and cover system shall meet the following design and third party testing requirements. Documentation of testing protocol and certified testing results shall be submitted to the engineer:
- Containing 45 percent to 70 percent fiber reinforcement
- Thermoset Resin with UV Inhibitors to prevent photodegredation
- Minimum strength to weight ratio of 750:1
- Integrated gasket (minimizes traffic shock, abates noise and odors, prevents water entry into manhole)
- Skid slip resistance greater than 0.6 as described in ASTM C1028 Standard
- Dimensional tolerance 1/16-inch

ii. Complete Fatigue Loading Test with no loss of carrying performance and no visible damage: Apply 16,000 pound point load for 2,000,000 cycles. A five (5) year guaranty shall be provided.

iii. Manhole frame and cover sets shall be manufactured by EJ Company or equal and modified to include the TITUS TwistLIFT Tamper Resistant Locking System keyed to YLWD format, and supplied by TITUS Industrial Group Inc., no equal. The contact information for TITUS is: Lewis Titus; direct phone (541) 948-4459; office phone (541) 389-1975; lewis@titusig.com.

iv. Manholes shall be equipped with lockable covers. Locks shall be TITUS TwistLift:
- Minimum two (2) locks per cover
- Type 316 Stainless steel bolts, twisted lock paddles, washers
- Nylon washers and jam nuts
- Plastic debris plugs
- Provide two sets of tools and materials: deep socket and torque wrench, open end wrench, opening tool, silicon grease

v. Certification: Contractor shall provide test results and other documentation from the Manufacturer to certify that the materials of fabrication and the finished product meet the specified requirements.

## C. Imported Sand

Imported sand shall comply with Section 02223, Trenching, Backfilling, and Compacting.

## D. Crushed Rock

Crushed rock shall comply with Section 02223, Trenching, Backfilling, and Compacting. Crushed rock shall be the same material as the pipe bedding. If rock is not used for the pipe bedding, 3/4-inch crushed rock shall be used for the manhole. Crushed rock material shall extend 1 foot beyond the outside edge of the concrete manhole base.

## E. Manhole Bases

Concrete used in pouring the manhole base shall be Class A concrete, Type II or Type V cement per Section 03300, Concrete.

## F. Cement-Mortar Grout

Grout for grade ring joints between precast sections shall be composed of one part portland cement to two parts of clean well-graded sand of such size that all pass a No. 8 sieve. Cement, aggregate, and water for mortar shall conform to the applicable provisions of Section 03300, Concrete.

## G. Epoxy Grout

Epoxy grout shall be used in repairing manhole and manhole base surfaces. Epoxy grout shall be made with epoxy and sand. The sand shall be clean, bagged, graded, and kiln dried silica sand. The prepared grout shall wet the contact surface and provide proper adhesion, or a coat of epoxy shall be applied prior to placing the epoxy grout. The epoxy bonding compound shall be as specified in Section 03300, Concrete.

## H. Plastic Joint Sealing Compound

Preformed cold-applied ready-to-use plastic joint sealing compound shall be Conseal CS-102 by Concrete Sealants, Quick-Seal by Quikset Utility Vaults, or for contracts between District and Contractor, approved equal and shall be used on all manhole shaft joints unless otherwise directed by the District representative.

# PART 3 - EXECUTION

## A. Work Within Existing Manholes

Any proposed work inside an existing manhole that is part of a sewerage system in service, shall not be undertaken until all the tests and safety provisions of Article 4, Section 1532 "Confined Spaces" State of California Construction Safety Orders have been made.

## B. Excavation

Excavation for the precast concrete manhole shall be in accordance with Section 02223, Trenching, Backfilling, and Compacting.

## C. Manhole Base

1. General: Manhole bases shall be poured in place against undisturbed soil with Class C concrete and a slump of not greater than 4-inches. The manhole base shall be poured as one monolithic pour. Limitations for site-mixed and ready-mixed concrete set forth in Section 03300, Concrete, shall be observed. If soil conditions are not adequate as determined by the District's Representative, a 12-inch thick base of 3/4-inch crushed rock shall be placed prior to the placement of concrete. See Standard Drawing S-1.

2. Manhole Stub Placement: 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 constructed per the YLWD Standard Drawings.

3. Matching Pipe Crown Elevations: Invert elevations of connecting sewers may vary depending upon sizes. The crown elevation of all pipes shall be the same as the crown elevation of the largest pipe unless otherwise indicated on the plans.

4. Channel Configuration: The invert of the manhole base shall be formed so as to provide smooth channels conforming in size and shape to the lower portions of the inlet and outlet pipes. The channel shall vary uniformly in size and shape from inlet to outlet, and a shelf shall be constructed higher than the pipe as indicated on the drawings. The manhole base shall extend 12-inches below the bottom of the lowest pipe.

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

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

7. Placement of Additional Mortar: 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 "Willhold Concrete Adhesive" in the amounts and proportions recommended by the manufacturer and as directed by the District Representative in order to secure as chip-proof a result as possible.

8. Curing Time Before Further Construction: Unless approved otherwise by the District, in advance, the bases shall set a minimum of 24 hours before the manhole construction is continued.

## D. Installing Manholes

1. General: Manholes for sewers of Diameter 10-inches or less shall be constructed as shown on Standard Drawings S-1 and S-2. Manholes for larger diameter sewers shall be constructed as shown on the plans.

2. Joints for Grade Rings: Precast concrete manhole units shall be set in a bed of grout to make a watertight joint at least 1/2 inch thick with the concrete base or with the preceding unit. Manhole sections shall be set perfectly plumb. Joints shall be pointed and the excess grout wiped off.

3. Finish Elevation of Manhole Covers: Precast sections shall be assembled so that the cover conforms to the elevation determined by the manhole location as

follows, but limited to a maximum of 18-inches of grade ring unless otherwise instructed by the District Representative.

a. In Paved Area: Top of cover shall be flush with the paving surface.

b. In Shoulder Areas: Top of cover shall be flush with existing surface where it is in traveled way or shoulder and 0.1 foot above existing surface where outside limits of traveled way but not in the existing roadside ditch.

c. In Roadside Ditch or Unpaved Open Areas: Top of cover shall be 6-inches above the ground surface with a gradual square Class "B" concrete collar as shown in Standard Drawing S-1. Guard posts or utility marker may be required adjacent to manholes in open areas. See the Special Provisions.

4. Manhole Frame and Cover: The manhole frame shall be bolted to grade ring and secured with grout and cement mortar fillet. After the frames are securely set, the frames and the covers shall be cleaned and scraped free of foreign materials, and shall be ground or otherwise finished as needed so the cover fits in its frame without rocking.

5. Watertightness: It is the intent of these specifications that manholes and appurtenances be watertight and free from infiltration. Enough cold-applied, preformed, plastic joint sealing compound shall be applied such that the compressed material protrudes from the interior and exterior of each manhole joint. The excess material on the interior shall be trimmed finish.

   Where called for in the plans or supplemental specifications, manholes that are to be given a protective lining or coating shall be free of any seeping or surface moisture. The adequacy of manholes and appurtenances as to watertightness shall be determined by the District Representative and shall be tested in accordance with Section 10543, Leakage and Infiltration Testing.

6. Stubs: Sewer pipe shall be furnished and installed in manholes at the locations shown and in conformance with the detail drawings and plans. All stubs shall be plugged with stoppers as shown on the plans for various sizes of pipe.

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

8. Bulkheads: Brick and mortar bulkheads shall be installed at the downstream end of all unused stub channels over 5 feet long to prevent the creation of a

septic condition resulting from ponding of sewage and debris in the unused channels, and until such time as the manhole stub is connected and normal sewage flow can occur. A plug shall be required for all downstream stubs.

9. New Connections to Existing Manholes: New connections to existing manholes wherein stubs have not been provided shall be made by core drilling through the base, as directed by the District Representative.

10. Backfill: Backfill around the precast concrete manhole shall be imported sand, and shall be placed and compacted in accordance with Section 02223, Trenching, Backfilling, and Compacting.

11. Grade Rings: Class B concrete rings shall be cast around manhole frames that are flush with the surface. The ring shall be placed after final grading or paving together with final cleanup.

12. Pavement Replacement: Replacement of bituminous or concrete pavement shall be in accordance with the requirements of the governmental agency having jurisdiction.

## E. Manhole and Manhole Base Repairs

Manhole sections and bases that exhibit defects in the concrete surface may be rejected. Defective concrete surfaces of manhole sections and bases not rejected shall be repaired by chipping away unsound or imperfect concrete. Edges shall be left sharp and square with the surface. Loose material and dust remaining after chipping shall be removed by means of an air jet. Epoxy grout shall be applied to the surface to be repaired in accordance with the manufacturer's instructions. The grout shall wet the contact surface and provide proper adhesion, or a coat of epoxy shall be applied prior to placing the epoxy grout.

## F. Manhole Lining

General: Where called for in the plans or project technical specifications, manholes shall be lined per the following requirements:

1. Work Included: The Contractor shall furnish all labor, material and equipment necessary for all traffic control, preparation of surfaces, application of lining, safety procedures per Cal-OSHA Permit Required Confined Space Requirements, protection of existing utilities or surfaces and equipment/jobsite cleanup.

2. Flow Control: Any flow control or bypass pumping necessary to perform lining will be coordinated with the District and performed by the Contractor.

3. Surface Preparation:

a. All concrete, brick or mortar surfaces to be lined shall be waterblasted to remove all deteriorated concrete, oil, grease, or existing coating to produce a good sound, clean concrete or brick. Any steps or stairs shall be removed as directed by the Engineer.

b. Waterblasting equipment shall be capable of 10,000 psi. Cleaning shall be accomplished with a minimum of 5,000 psi using no detergents, solvents or chemicals of any kind.

c All debris produced from the Waterblasting operation shall be removed from the manhole prior to coating. No debris shall be allowed to enter the sewer system. The concrete surfaces shall be air dried prior to lining application.

d Concrete manholes with more than 1-inch of concrete loss shall receive a minimum 1-inch Gunite mortar coat and be allowed to cure for 24 hours prior to lining application. The gunite shall be as specified in Section 303-2.1.2, Method A, of the Standard Specifications for Public Works Construction Latest Edition (Green Book).

e. Any surfaces subject to immersion service shall be abrasive blasted to provide a good anchor profile to promote adhesion for the adhesion.

f. A representative of the lining material manufacturer shall visit the site to meet with the Contractor and District and witness and approve the quality of the surface preparation to the manufacturer's requirements prior to application of the lining. The liner material manufacturer shall provide a written approval to the District.

4. Infiltration Control: All active structure infiltration must be eliminated prior to liner application. Infiltration control will be treated as extra work and as directed by the District. All grouting shall be completed in accordance with NASSCO Specifications (Refer to 8th edition, January 1994 NASSCO Specification on manhole sealing (page 130 section 3a).

5. Liner Application:

a. The lining application shall be performed only by workmen trained and experienced with the specified material. The Contractor shall provide proof of such experience with the bid documents. Proof shall include a list of similar projects using the specified material. The lining shall be applied through plural component equipment specifically designed and approved by the manufacturer of the lining material. The equipment

shall be in good working order to insure correct proportioning and mixing of the components.

b. The lining shall be applied to a minimum thickness of 125 mils (1/8 inch) in one continuous coat, without seams, free from any holes or defects. The lining shall be installed over all exposed edges. Manhole walls shall be coated prior to placing manhole rings. Lining shall be applied over manhole rings after installation, to a minimum distance of 4" beyond the joints. For existing manholes, remove rings and follow same coating sequence to achieve an identical finish product.

c. During lining application, the Contractor shall take wet gauge thickness readings as required to insure correct lining thickness.

d. The uniform lining shall be free from porosity, without bubbles or pinholes and uniform in color. All areas in question shall be removed, reworked and patched.

e. Application of the lining shall not take place when exposed to rain, or high winds. It is the Contractor's responsibility to insure protection of the work from the above mentioned conditions.

f. The complete coating shall be impermeable to sewer gases and liquids and non conductive to bacterial or fungus growth.

g. The lining shall be capable of repair at any time during its life.

6. Lining Materials:

a. Type 1. Spray Applied Polyurethane: Sancon 100 as manufactured by Sancon Engineering, Inc., Zebron as manufactured by Zebron, Utilithane 1600 Polyurethane as manufactured by Prime Coatings Incorporated, or equal.

Prime Coating**:** Prior to application of the lining, all surfaces shall receive a one (1) to three (3) mil thickness of 100% solids non-solvented, moisture tolerant epoxy primer.

The lining material shall be a two-component, 100% solid, non-solvent hybrid polyurethane coating, with a shore "D" hardness of 57 at 77 degrees Fahrenheit. The material shall be the high-build type capable of application thickness, as specified, without runs or sags, and shall be capable of passing ASTM D-1737 for flexibility, using cylinder mandrel of 0.5 inch (12.7 millimeter). The flash point of the fluid mixture shall be 450 degrees Fahrenheit open Zahn cup. Lining material shall meet or exceed the requirements of 210-2.3.3 and 500-

2.4.10 of the Standard Specifications pertaining to Chemical Resistance and Physical Properties. Proof of meeting these requirements shall be provided as part of the bid submittal and shall be confirmed by the Engineer 15 days prior to commencement of work.

The color shall be white or cream.

b. Type 2. Spray Applied Epoxy: Raven 405 as manufactured by Raven Lining Systems, Inc., Sewergard 210S as manufactured by Sauereisen, NPR 5300 series Pure Epoxy as manufactured by NeoPoxy Corporation, or equal.

c. Epoxy Lining Material:

1) Epoxy lining material shall be 100% solids solvent-free two component epoxy resin that can be applied to 200 mils or more in a single coat.

2) Proof of the materials having passed the Greenbook Section 210-2.6.3 shall be submitted at the pre construction meeting.

3) The following characteristics must be confirmed by submitting test results from an independent testing laboratory:

| | |
|---|---|
| Product Type: | Polyamine or Amine cured epoxy resin |
| Solids Content: | 100% |
| Solvent Content: | 0% |
| Minimum Flexural Modulus: | 450,000 PSI |
| Minimum tensile elongation: | 1.5% |
| Minimum Compressive Strength: | 10,000 PSI |
| Minimum Hardness, Type "D" | 80 |
| Minimum Bond Strength: | Tensile strength of concrete |
| Chemical Resistance: | SSPWC Sec. 210-2.6.3 approved in advance by the Engineer |

d. Material Substitution:

1) Materials specified are those which have been evaluated for the specific service are listed to establish a standard of quality. Standard products of manufacturers other than those specified may be accepted when it is proved to the satisfaction of the District they meet Standard Specifications requirements, are equal in composition, durability, usefulness, and convenience for the purpose intended. Substitution will be considered provided the following minimum conditions are met:

2) The proposed lining system shall have a dry film thickness equal to or greater than that of the specified system.

3) The proposed lining system shall employ an equal number of coats.

4) The proposed lining system shall employ coating of the same generic type.

5) The proposed lining system shall have been successfully used in 10 similar sewer wet well projects, in California and have been in active service for at least five years.

6) All requests for substitution shall carry full descriptive literature and directions for application, along with complete information, generic type and non-volatile content by volume. Proof of having passed the Standard Specifications Section 502-4.3 chemical resistance testing requirements shall also be submitted.

7) In the above-mentioned data, if it appears to be in order, the Engineer may require that the Contractor provide certified laboratory data sheets showing proposed substitute. Tests shall be performed by an independent testing laboratory satisfactory to the Engineer and all costs incurred in the testing program shall be borne by the Contractor. The Engineer shall be sole and final judge of the acceptability of any proposed substitution. Requests for substitution must be pre-approved in writing before the bid.

8) The manufacturer and installer of the polyurethane or epoxy material shall warrant its lining for five years against any type of failure due to defects in material and application. A copy of the warranty shall be submitted to the Engineer prior to application.

7. Testing and Inspection:

   a. Except as otherwise indicated, inspection, sampling and testing of construction will be provided by the Contractor and the costs included in the bid price. Any additional inspection or testing required due to non-conformance with the contract requirements shall be provided by the District at the Contractor's expense.

   b. The Contractor shall facilitate inspection and testing by providing access as required by the appropriate parties and 48 hours minimum notice to the District.

   c. The testing and inspections described herein are solely for the use of the District in determining acceptance of the work. The Contractor shall perform inspection and testing at Contractor's expense to assure compliance with the contract requirements.

8. Thickness Testing: During application of the manhole lining a wet film thickness gauge will be used in accordance with ASTM D4414 to confirm a uniform coating of the required thickness.

9. Holiday Testing: Holiday testing will be performed in accordance with ASTM D5162 at an inspection voltage of 100 volts per mil. All detected holidays shall be marked and repaired by the Contractor following the lining manufacturer's recommendations.

10. Bond Strength Testing:

   a. Epoxy coating bond strength shall be tested by the Contractor in accordance with ASTM D4541 at eight (8) locations per manhole chosen by the District. Any areas detected to have inadequate bond strength will be evaluated by the District. Further bond tests shall be performed in that area to determine the extent of potentially deficient bonded area and repairs shall be made by the Contractor in strict accordance with manufacturer's recommendations. The passing criteria shall be a pull resulting in concrete failure and with concrete visibly bonded to the test section of coating material. All test areas shall be patched by the Contractor with the specified lining.

   b. A representative of the lining manufacturer shall visit the site to meet with the Contractor, and District and witness the pull testing and supply a written verification of adherence to the manufacturer's requirements.

11. Manufacturer's and Applicator's Written Warranty:

   The Contractor shall supply a written five (5) year warranty on the materials

and workmanship of the installed liner to the District.

The liner material manufacturer shall supply a written five (5) year warranty on the materials and workmanship of the installed liner to the District. Contractor shall remove and replace all failures at their own expense during the warranty period.

Measurement and Payment: The contract lump sum price in the bid schedule shall include furnishing all traffic control, tools, materials, testing, labor, equipment, site visits, travel expenses, warranties and all other items necessary for a complete rehabilitation of the sewer wet well complete, in place, per the specifications, and no additional compensation will be allowed therefore."

**END OF SECTION**

# SECTION 03462

# PRECAST CONCRETE VAULTS AND METER BOXES

## PART 1 - GENERAL

### A. Description

This section describes the materials, manufacture, and installation of precast concrete vaults and meter boxes.

### B. Related Work Specified Elsewhere

1. Structure Earthwork: 02220

2. Trenching, Backfilling and Compacting: 02223

3. Concrete Joints and Waterstops: 03260

4. Concrete: 03300

5. Structural Steel and Miscellaneous Metalwork: 05120

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300 and the following.

2. Submit manufacturer's catalog data on precast concrete vaults and meter boxes. Show dimensions and materials of construction by ASTM reference and grade.

### D. Standard Drawings

For pipeline diameters 10-inches and smaller, vault and meter box sizes and configuration shall be as shown on Standard Drawings W-1, W-2, W-4, W-5, and W-15.

## PART 2 - MATERIALS

### A. Precast Concrete Vault

1. Manufacturers: Precast concrete vaults and covers shall be manufactured in a plant especially designed for that purpose and shall conform to the size, shape and dimensions indicated on the detailed plans. Vaults and covers shall be Christy Concrete, Eisel Enterprises, Inc. J & R Concrete Products, Inc., Jensen Precast, Olson Precast, or for contracts between District and Contractor, approved equal.

2. 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 based on H-20 loading per AASHTO standard specifications for highway bridges. Design wheel load shall be 16 kips. The live load shall be that which produces the maximum shear and bending moments in the structure.

3. Concrete: Concrete for vaults and meter boxes units shall be Class A conforming to Section 03300, Concrete.

4. Sectional Vaults: Sectional precast concrete vaults may be used where specified on the drawings or approved by the District Representative.

### B. Meter Boxes and Covers

1. Materials: Meter boxes and covers shall be manufactured of composite material by Oldcastle or Armorcast.

2. Meter Box Covers: Meter box covers shall be manufactured by Oldcastle or Amorcast.

3. Traffic Covers: Meter box covers within roadways or driveways shall be one lipped cast-iron or steel lid piece, designed to withstand H-20 highway loading, and may only be used where specified on the plan or approved by the District.

4. Meter Box Size

   a. For 1-inch Meters – Nominal inside dimensions shall be 13 3/8-inches wide x 24-inches long x 12-inches deep.

   b. For 1½- and 2-inch Meters – Nominal inside dimensions shall be 18½-inches wide x 30-inches long x 12-inches deep.

5. Manufacturers: Meter boxes shall be manufactured by Oldcastle or Armorcast.

## C. Vault Frames and Covers

1. Materials: Unless noted otherwise, vault frames and covers shall be fabricated of aluminum in accordance with the requirements of Section 05120, Structural Steel and Miscellaneous Metalwork.

2. Covers: Covers shall be fabricated with supports to prevent permanent deflection.

## D. Joint Sealing Compound

The joint sealing compound shall be permanently adhesive flexible plastic material complying in every detail to Federal Specification SS-S-00210 (GSA-FSS). Joint sealing compound shall be Conseal by Concrete Sealants, Quick-seal by Quikset Utility Vaults, or for contracts between District and Contractor, approved equal.

# PART 3 - EXECUTION

## A. Earthwork

1. General: Excavation and backfill for precast concrete vaults and meter boxes shall be in accordance with Section 02220, Structure Earthwork, and the requirements herein. Excavation limits shall be large enough to accommodate the structure and permit grouting of openings and backfilling operations.

2. Sub-base: The bottom of the structure shall be placed on 12-inches of compacted, crushed rock sub-base, graded level and to the proper elevation as shown on the plans and shall conform to the specifications in Section 02220, Structure Earthwork.

## B. Vault Installation

1. Vault Wall Openings: 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 coupling flange. Upon completion of installation, all voids or openings in the vault walls around pipes shall be filled with Class A concrete or mortar, using an epoxy for bonding concrete surfaces, as specified in Section 03300, Concrete.

2. Backfill: After the structure and all appurtenances are in place and approved, backfill shall be placed to the original groundline or to the limits designated on the plans.

3. Watertightness: All joints between precast concrete vault sections shall be made watertight. The sealing compound shall be installed according to the manufacturer's recommendations to provide a watertight joint.

4. Installed Elevation: Vaults shall be built up so that the cover is flush with the surrounding surface unless otherwise specified on the drawings or by the District Representative in the field. The Contractor is responsible for placing the cover at the proper elevation and slope where paving is to be installed, and shall make all necessary adjustments so that the cover meets these requirements.

## C. Meter Box Installation

1. Line and Grade: Meter boxes shall be set true to line and to the grade of the top of the curb, sidewalk, or surrounding graded area.

2. Sequence of Installation: Meter boxes shall not be set until fine grading or landscape grading in the vicinity has been completed.

**END OF SECTION**

# SECTION 05120

# STRUCTURAL STEEL AND MISCELLANEOUS METALWORK

## PART 1 - GENERAL

### A. Description

This section describes materials and installation of structural steel, connecting bolts, stainless-steel fasteners, ladders, access hatches, and gratings.

### B. Related Work Specified Elsewhere

1. Concrete: 03300

2. Painting and Coating: 09900

3. Standard Specifications for Public Works Construction

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300 and the following.

2. Submit drawings of fabricated items, such as pipe supports, bolts, ladders, concrete anchors, grating, and access hatches. Show dimensions and reference materials of construction by ASTM designation and grade.

### D. Quality Assurance

1. Qualifications:

   a. Perform welding of structural metals with welders who have current American Welding Society certificate for the type of welding to be performed.

   b. Notify District Representative 24 hours minimum before starting shop or field welding.

   c. District Representative may check materials, equipment, and qualifications of welders.

   d. Remove welders performing unsatisfactory Work, or require requalifying.

e. District Representative may use gamma ray, magnetic particle, dye penetrant, trepanning, or other visual inspection aids to examine any part of welds or all welds.

f. Contractor shall bear costs of retests on defective welds.

g. Contractor shall also bear costs in connection with qualifying welders.

h. Provide special inspection for the installation of chemical anchors in accordance with the Uniform Building Code (UBC).

**E. Delivery, Storage, and Handling**

1. Packing and Shipping: Deliver structural steel free from mill scale, rust, and pitting.

2. Storage and Protection: Until erection and painting, protect from weather items not galvanized or protected by a shop coat of paint.

## PART 2 - MATERIALS

**A. Structural Steel**

Material for all-purpose bolted or welded construction shall conform to ASTM A 36.

**B. Aluminum**

Structural shapes shall conform to ASTM B 308, Alloy 6061-T6. Plates and sheets shall conform to ASTM B 209. Tubing shall conform to ASTM B 241.

**C. Steel Bolts**

Steel anchor and connection bolts shall conform to ASTM A 307, Grade A4 and shall be fitted with self-locking nuts or lockwashers and plain nuts, and shall be galvanized.

**D. Beveled Washers**

Washers for American Standard beams and channels shall be square or rectangular, tapered in thickness, smooth, and hot-dipped galvanized conforming to ASTM F 436.

## E. Galvanizing

Zinc coating for all plates, bolts, anchor bolts, and threaded parts shall be hot-dipped coated in accordance with ASTM A 153. Structural steel and pipe shall be zinc coated in accordance with ASTM A 123.

## F. Stainless Steel

Except where otherwise specified, stainless steel plate, members, and washers shall be Type 316, ASTM A 167. Bolts shall be ASTM A 193, Grade B8M. Nuts shall be ASTM A 194, Grade 8M.

## G. Welding Electrodes

Welding electrodes for structural steel shall conform to AWS A5.5. Use electrodes in the E-70 series. Welding electrode for aluminum shall be 4043 filler metal and Type 347 electrode for stainless steel.

## H. Ladders

1. General: Ladders shall be fabricated as shown on the drawings and shall comply with OSHA Safety Standards. Ladders shall be of welded steel construction and galvanized after fabrication or stainless steel where indicated on the drawings.

2. Safety Devices: When indicated on the plans, a safety climb device (ladder fall prevention device) shall be provided, consisting of a SAF-T-NOTCH rail, standard attaching parts, SAF-T-LOK sleeve, SAF-T-CLIMB removable extension, and two complete safety belt assemblies. The device shall comply with OSHA requirements and shall be SAF-T-CLIMB as manufactured by Air Space Devices Norton Co., Paramount, California, or for contracts between District and Contractor, approved equal. All safety climb device assemblies and parts shall be fabricated of Type 304 stainless steel.

## I. Concrete Anchors

Drilled anchors shall be Type 316, stainless steel wedge anchors, unless otherwise indicated, as manufactured by Phillips Drill Company, or for contracts between District and Contractor, approved equal. Where steel anchors are indicated, they shall be one-piece design with expander ring consisting of steel zinc coated and chrome plated as manufactured by McCullough Industries, Inc., Kwik Bolt, or for contracts between District and Contractor, approved equal.

## J. Access Hatches

Aluminum access hatches shall be of the size and type indicated on the drawings. Hardware shall be 316 stainless steel and shall include but not be limited to hinges, hold-open arms, springs, and spring covers. Hatches shall be equipped with extruded aluminum channel trough frames with 1-1/2 inch drain coupling, flush aluminum drop handles which do not protrude above the cover, a recessed padlock box and stainless steel staple sized for a No. 6 padlock, slam lock feature, hold open arm, and a safety grate.

## K. Grating

Grating shall be aluminum. Main bars shall be of the size and thickness indicated on the drawings.

# PART 3 - EXECUTION

## A. Fabrication and Erection

1. General: Miscellaneous metal items shall be fabricated to straight lines and true curves. Drilling and punching shall not leave burrs or deformations. Permanent connections shall be welded continuously along the entire area of contact. Exposed work shall have a smooth finish with welds ground smooth. Joints shall have a close fit with corner joints coped or mitered and shall be in true alignment. Unless specifically indicated, there shall be no bends, twists, or open joints in any finished member nor any projecting edges or corners at intersections. Fastenings shall be concealed wherever possible. Built-up parts shall be free of warp. Exposed ends and edges of metal shall be slightly rounded. All boltholes shall be 1/16-inch in diameter larger than bolt size. Cast-in-place bolt locations shall be measured in the field before drilling companion holes in structural steel beam or assembly.

2. Surfaces in Contact with Concrete: Surfaces of metalwork to be in contact with concrete shall be cleaned of rust, dirt, grease, and other foreign substances before placing concrete.

3. Embedded Metalwork: Embedded metalwork shall be set accurately in position when concrete is placed and supported rigidly to prevent displacement or undue vibration during or after the placement of concrete. Unless otherwise specified, where metalwork is to be installed in recesses in formed concrete, said recesses shall be made, metalwork installed, and recesses filled with dry-pack mortar in conformance with Section 03300.

## B. Ladders

Ladder rungs shall have a minimum diameter of 3/4-inch. The distance between rungs, cleats, and steps shall not exceed 12-inches and shall be uniform throughout the length of the ladder. The minimum clear length of rungs or cleats shall be 16-inches. Ladders shall be mounted to provide clearance in back of ladder so that the distance from the centerline of rungs, cleats, or steps to the nearest permanent object in back of the ladder shall be not less than 7-inches.

## C. Common Machine Bolts and Nuts

1. General: Bolts shall be inserted accurately into the boltholes without damaging the thread. Boltheads shall be protected from damage during driving. Boltheads and nuts shall rest squarely against the metal. Where bolts are to be used on beveled surfaces having slopes greater than 1 in 20 with a plane normal to the bolt axis, beveled washers shall be provided to give full bearing to the head or nut. Where self-locking nuts are not furnished, bolt threads shall be upset to prevent the nuts from backing off.

2. Bolt Insertion: Bolts shall be of the length that will extend entirely through but not more than 1/4-inch beyond the nuts. Boltheads and nuts shall be drawn tight against the work. Boltheads shall be tapped with a hammer while the nut is being tightened. After having been finally tightened, the nuts shall be locked. If the bolthead does not allow insertion due to space restrictions, an all-threaded bolt shall be used as a substitute. Cutting of boltheads to permit insertion of the bolt is prohibited.

## D. Anchor Bolts and Anchors

1. General: Bolts and anchors shall be preset by the use of templates. Concrete anchors shall not be used where cast-in-place anchor bolts are called for.

2. Protection of Anchor Bolts: After anchor bolts have been embedded, bolt threads shall be protected by applying grease and be having the nuts screwed on until the time of installation of the equipment or metalwork.

## E. Control of Flame Cutting

The use of a gas-cutting torch in the field for correcting fabrication errors on any member in structural framing shall not be permitted. A flame-cutting torch shall be used only on minor members, when the member is not under stress.

## F. Repair of Galvanized Surfaces

Damaged galvanized metal surfaces shall be repaired or replaced at no additional cost to the District. Repair of galvanized surfaces shall be accomplished by use of

DRYGALV as manufactured by the American Solder and Flux Company; Cold Galvanizing Repair Compound as manufactured by Rust-Oleum, applied in accordance with the manufacturer's instructions; or for contracts between District and Contractor, approved equal.

## G. Storage of Materials

All material, either plain or fabricated, shall be stored above ground on platforms, skids, or other supports. Material shall be kept free from dirt, grease, and other foreign matter and protect from corrosion.

## H. Welding

1. Steel: Welding of steel shall be performed by the Shielded Metal Arc Welding (SMAW) process. Welding procedures shall comply with AWS D1.1.

2. Aluminum: Welding of aluminum shall be performed by the Gas Metal Arc (MIG) or Gas Tungsten Arc (TIG) process, per the AWS Welding Handbook.

## I. Grating

1. Measurement: Grated areas shall be field measured for proper size.

2. Banding: Grating shall be completely banded.

3. Grating Angles: Seat angles for grating shall be set so that the top of the vertical leg is flush with the concrete floor. Seat angles and anchors shall be stainless steel.

## J. Corrosion Protection

Aluminum surfaces that are in contact with or embedded in concrete shall be coated in accordance with Section 09900, Painting and Coating. Coating shall be allowed to dry before placing in or against concrete.

**END OF SECTION**

# SECTION 09880

# POLYVINYL CHLORIDE PLASTIC LINERS

## PART 1 - GENERAL

### A. Description

This section describes materials, installation, and testing of polyvinyl chloride (PVC) liners, where called for, in reinforced concrete pipe, and cast-in-place concrete structures.

### B. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300 and the following.

2. Submit installation details showing how manholes will be lined. Show returns, corners, joints, and coverage. Show location and type of field welds.

3. Submit manufacturer's test data, catalog data, and descriptive literature of the plastic liner, adhesives, solvents, and activators.

4. Submit manufacturer's installation instructions.

## PART 2 - MATERIALS

### A. Manufacturers

Plastic liner shall be Ameron Amer-Plate T-lock liner as manufactured by Ameron, Koroseal Lok-Rib as manufactured by B. F. Goodrich, or for contracts between District and Contractor, approved equal.

### B. Liner Composition

1. Material: The materials used in all sheets of plastic liner and in joint, corner and welding strips for the liner shall be high molecular weight PVC resin and other necessary ingredients compounded to make permanently flexible sheets and strips for lining precast concrete manholes. PVC resin shall constitute not less than 99%, by weight, of the resin used in the formulation. Copolymer resins shall not be used. Changes in formulation may be permitted only after prior approval by the District and only if the manufacturer can demonstrate that

the plastic liner meets or exceeds all requirements in this specification for chemical resistance and physical properties.

2. Color: Liner shall be white in color.

3. Joint Strips: The material used in joint strips and in plain sheets of plastic liner shall be identical to that used in sheets having locking extensions.

4. Impermeability: Plastic liner shall be impermeable to sewage gasses and liquids and shall be nonconductive to bacterial or fungus growth. Liner shall be factory checked electrically to ensure freedom from any porosity.

5. Physical Properties: The lining shall be flexible, shall have good impact resistance, and shall have an elongation sufficient to bridge up to a 1/8-inch settling crack without damage to the lining.

## C. Physical Properties and Chemical Resistance Testing

1. Samples for Testing: The District's Representative, at any time during manufacture or at any time prior to completion of the work, may direct sampling and testing of materials. Holes left by coupon removal shall be repaired by the Contractor. The samples thus taken shall be subjected to the tests described below:

   a. Specimens shall be prepared and tested for tensile strength and elongation in accordance with ASTM D 412, Dye B. Indentation hardness shall be determined in accordance with ASTM D 2240 using a Type D durometer. Specimens shall be cut from sheets, joint strips and flat welding strips.

   b. Weight change specimens shall be 1-inch by 3-inch sample of the sheet thickness.

2. Description of Test: Test specimens shall be conditioned to a constant weight at 110°F before and after submersion in the following solutions for a period of 112 days at 77°F +/- 5°F. At 28-day intervals, tensile specimens and weight change specimens shall be removed from each of the chemical solutions and tested.

| Chemical Solution | Concentration Percentage |
|---|---|
| Sulphuric Acid | 20* |
| Sodium Hydroxide | 5 |
| Ammonium Hydroxide | 5* |
| Sodium Hypochlorite | 1* |
| Nitric Acid | 1* |
| Ferric Chloride | 1 |
| Soap | 0.1 |
| Detergent (Linear Alkyl Benzyl Sulfonate or LAS) | 0.1 |
| Bacteriological BOD not less | than 700 mg/l |

*Volumetric percentages of concentrated C.P. grade reagents.

Plastic liner sheets, joint, corner, and welding strips shall have the following physical properties when tested at 77°F +/- 5°F:

| Property | Initial | After 112 Days Exposure in Above Listed Chemical Solutions |
|---|---|---|
| Tensile Strength | 2.200 psi min. | 2,100 psi min. |
| Elongation at Break Shore | 200% min. | 200% min. |
| Durometer, Type D | Inst. 50-60 | ±5 (with respect |
| Weight Change | 10-sec. 35-50 | ±5 to initial |
| | | ±1.5% test results) |

If any specimen fails to meet the 112-day requirements before completion of the 112-day exposure, the material shall be rejected.

3. Pull Test of Liner Embedded in Concrete: Liner locking extensions embedded in concrete shall withstand a test pull of at least 100 pounds per linear inch, applied perpendicularly to the concrete surface for a period of one minute, without rupture of the locking extensions or withdrawal from embedment. This test shall be made at a temperature between 70°F to 80°F, inclusive.

4. Freedom from Physical Defects: Plastic liner sheets, including locking extensions and all joint, corner, and welding strips, shall be free of cracks, cleavages, or other defects adversely affecting the protective characteristics of the material.

5. Period During which Tests may be Conducted: Specimens taken from sheets and strips at any time prior to final acceptance of the work, when tested as specified, shall meet the requirements set forth above.

## D. Dimensions

1. Thickness of Material: Liner bonded to concrete by means of integral locking extensions embedded in the concrete shall have a minimum thickness of 0.065-inch. Liner which is to be bonded to concrete or steel surfaces by means of adhesive shall have a minimum thickness of 0.094-inch. Welding strips shall have a minimum thickness of 0.095-inch and maximum thickness of 0.156-inch. Joint strips shall have a minimum thickness of 0.075-inch.

2. Sheet and Strip Size: Sheets of liner shall be as large as practicable to fit the intended use. Large sheets shall be formed in the shop by lapping basic size sheets a minimum of 0.50-inch and fusing the sheets together to produce a continuous welded joint. Specimens taken from shop-welded joints shall show no cracks or separation and shall be tested for tensile strength. Each specimen shall withstand a minimum load of 132 pounds per linear inch of weld or the product of 2,000 psi times the minimum thickness in inches of the material adjoining the weld, which ever is greater. The thickness shall be taken within a 2-inch gage length.

3. Cause for Rejection: Sheets having tears, cracks or separation in the laps shall be rejected.

4. Joint Strips: Joint strips shall be 4-inches +/-0.25-inch in width and shall have each edge beveled prior to application.

5. Welding Strips: Welding strips shall be 1-inch +/-0.125-inch in width. Welding and outside corner strips shall have edges beveled at the time of manufacture.

## E. Locking Extensions

1. General: Liners cast into concrete shall have integral locking extensions embedded in the concrete. Liner may be bonded to concrete surfaces with an adhesive only if specifically shown on the drawings.

2. Material: Locking extensions shall be of the same material as the liner and shall be integral with the sheets of liner.

3. Dimensions: Locking extensions shall have an approved cross section with a minimum height of 0.375-inch and a minimum web thickness of 0.085-inch. They shall be approximately 2-1/2-inches apart and shall be such that, when the extensions are embedded in concrete, the liner will be held permanently in place.

4. Orientation: Locking extensions shall be parallel and shall be continuous except where omitted for joint flaps, transverse weep channels, and strap channels. Weep channels which involve the omission of locking extensions may be made during the manufacture of liner.

## F. Weep Channels

1. General: At 8-foot maximum intervals along liner longitudinally, a gap not less than 2-inches (3-1/2-inches in the case of extruded sheets) nor more than 4-inches wide shall be left in all locking extensions for liners of cast-in-place structures to provide an unobstructed transverse weep channel. Any area behind liner that is not properly served by regular weep channels shall have additional weep channels 2-inches wide provided by cutting away locking extensions. Provisions shall be made to permit water behind the liner of concrete manhole shafts to drain into the weep channels of the lined structure. Weep channels shall be cut into the extruded sheet so that a maximum of 1/32-inch of the base locking extension is left on the sheet.

2. Weep Channels for Liners in Cast-in-Place Structures: At transverse joints in cast-in-place structures, a gap of not less than 2-inches nor greater than 4-inches shall be left in all locking extensions to provide a transverse weep channel. If locking extensions are removed to provide a weep channel at joints, the base of the extension left on a sheet shall not exceed 1/32-inch.

3. Weep Channels in Liner where Lined-Surfaces Join Unlined Surfaces: A transverse weep channel shall be provided approximately 12-inches from each liner return where surfaces lined with plastic liner join surfaces that are not so lined.

4. Cleaning Weep Channel Outlets: As part of the work of installing the liner, all outlets of transverse weep channels shall be cleared of obstructions that would interfere with their proper function.

## G. Flaps

When transverse flaps are required, they shall be fabricated so that a maximum of 1/32-inch of base of the locking extensions is left on the sheet.

## H. Adhesives and Cleaners

1. Adhesives: Adhesives which will deleteriously affect the liner or strip in any way shall not be applied to the liner or to any of the liner strips. Flammable adhesives and solvents shall not be used for any purpose in connection with plastic liner with locking extensions.

2. Cleaning Agents: Cleaning agents for use with plastic liner with locking extensions shall be a water soluble or dispersible nonflammable product not detrimental to the plastic liner.

## I. Factory Testing

The liner shall be shop tested for holes with a spark tester set to provide from 15,000 to 20,000 volts. Prior to shipment from the manufacturer's plant, sheets having holes shall be shop-repaired and retested. Repairs shall be made by welders qualified as specified below. The District's Representative may test samples at the point of manufacture during production of sheet and strip material.

# PART 3 - EXECUTION

## A. Qualification of Installers

1. Applicators: The application of plastic liner to forms and other surfaces shall be considered as highly specialized work, and personnel performing this type of work shall be trained in methods of installation.

2. Welders: Each welder shall pre-qualify by successfully passing a welding test before doing any welding. Pre-qualification may be required at any time deemed necessary by the District's Representative. All test welds shall be made in the presence of the District's Representative and shall consist of the following:

   a. Two pieces of liner, at least 15-inches long and 9-inches wide, shall be lapped 1-1/2-inches and held in a vertical position.

   b. A welding strip shall be positioned over the edge of the lap and welded to both pieces of liner. Each end of the welding strip shall extend at least 2-inches beyond the liner to provide tabs.

   c. The weld specimen shall be submitted to the District's Representative and will be tested as follows:

      1) Each welding strip tab, tested separately, shall be subjected to a 10-pound pull normal to the face of the liner with the liner secured firmly in place. There shall be no separation between the welding strip and liner when the welding tables are submitted to the test pulls.

      2) Three test specimens shall be cut from the welded sample and tested in tension across the welds. If none of these specimens

fail when tested as specified in Part 2, Subsection D.2, the weld will be considered as satisfactory in tension.

3) If one of the specimens fails to pass the tension test, a retest will be permitted. The retest shall consist of testing three additional specimens cut from the original weld sample. If all three of the retest specimens pass the test, the weld will be considered satisfactory.

d. A disqualified welder may submit a new welding sample after receiving sufficient off-the-job training to warrant reexamination.

**B. Installation of Plastic Liner**

1. General: The plastic liner shall be applied in accordance with the manufacturer's instructions, the drawings, and the following:

2. Attachment to Concrete Structures: As cast into the concrete of structures, the lining shall be attached permanently and physically to the concrete by embedment of the locking extension mechanism. An adhesive bond shall not be used unless otherwise specified at a specific location. The lining shall be attached to metal surfaces by applying the lining manufacturer's adhesive to the metal surface and then installing the liner. The lining shall withstand a 15-psi back hydrostatic pressure applied to the under surface of the lining without losing anchorage or without rupture or leakage.

3. Freedom from Defects: Liners shall be located and installed in accordance with the drawings and in such a manner as to be continuous and free from holes, defects, or other faults that may limit the liner's effectiveness as a corrosion-control barrier. Joint welding and sealing shall be equally as effective as the liner.

4. Orientation: Liners shall be installed in cast-in-place structures or pipe so that the locking extensions are parallel to the axis of the structure, and installed in other structures with locking extensions horizontal unless otherwise indicated on the drawings.

5. Fit: Liner sheets shall be closely fit to inner forms. Sheets shall be cut to fit curved and warped surfaces using a minimum number of separate pieces.

6. Joints: At transverse joints between regular size sheets of liner used in cast-in-place structures and at pipe joints, the space between ends of locking extensions, measured longitudinally, shall not exceed 4-inches. Where sheets are cut and joined for the purpose of fitting irregular surfaces, this space shall not exceed 2-inches.

7. Penetrations through Liner: Where form ties or form stabilizing rods pass through liner, the liner shall be maintained in close contact with the forms during concrete placement.

8. Liner Returns: Liner returns shall be installed where shown on the drawings and wherever surfaces lined with plastic liner join surfaces which are not so lined, such as brick, clay pipe, cast-iron pipe, manhole frames and metal or plastic gate guides. Unless otherwise indicated, returns shall be made as follows:

   a. Each liner return shall be a separate strip of liner at least 3-inches wide joined to main liner by means of corner strips.

   b. Corner strips shall be welded continuously to the return and to the main liner and applied wherever possible from the back of the lining.

   c. Locking extensions shall be provided on returns to lock the returns to the concrete of plastic-lined, cast-in-place structures.

9. Fastening Liner to Adjacent Construction: Each liner shall be sealed to adjacent construction with which it is in contact with adhesive or as shown on the drawings.

## C. Liner Field Joining

1. General: Field joints in the liner shall not be made until the structure has been backfilled and 30 days has elapsed. Where groundwater is encountered, joints shall not be made until pumping of the groundwater has been discontinued for at least 30 days and no visible leakage is evident at the joint. Liner at joints shall be free of mortar and other foreign material and shall be clean and dry before joints are made.

2. Hot Joint Compound: Hot joint compound shall not be brought into contact with liner.

3. Coating Restriction: No coating of any kind shall be applied over any liner joint, corner, or welding strip except where non-skid coating is applied to liner surfaces.

4. Field Joints in Cast-in-Place Structures: Field joints in liner on cast-in-place structures shall be one of the following types:

   a. Type C-1: A Type C-1 joint shall be made using a 4-inch joint strip, centered over the transverse joint and secured along each edge to adjacent liner by means of a welding strip. The width of the space between adjacent sheets of liner in a Type C-1 joint shall not exceed

1/2-inch. This type of joint is the only type permitted at transverse contraction joints in concrete. Its only other use is for joints between pipes and cast-in-place structures.

b. Type C-2: A Type C-2 joint shall be made by overlapping sheets not less than 1½-inches and securing the overlap to the adjacent liner by means of a welding strip. The upstream sheet shall overlap the downstream sheet. The length of that part of the overlapping sheet not having locking extensions shall not exceed 4-inches. A welding strip shall be applied to the back of the joint. This type of joint may be used at any transverse liner joint other than those collateral with joints in concrete and shall be used for liner joints made at longitudinal joints in concrete.

c. Type C-3: A Type C-3 joint shall be made by butting sheets of liner together and applying a welding strip over the back of the joint before concrete is poured and applying a welding strip over the front of the joint after concrete is poured. A Type C-3 joint shall not be used at a transverse joint which extends to a lower terminal edge of liner or at any joint where the gap between adjoining sheets of liner exceeds 1/8-inch.

5. Field Joints in Pipe Installations: Field joints in liner at pipe joints shall be one of the following types:

a. Type P-1. A Type P-1 joint shall consist of a 4-inch joint strip, centered over the mortared pipe joint and secured along each edge to adjacent liner by means of a welding strip. The gap between ends of lock extensions shall not exceed 4-inches.

b. Type P-2. A Type P-2 joint shall be made with an integral part of the liner extending 4-inches, ±¼-inch, beyond the spigot end of the pipe, overlapping the liner downstream from the pipe joint by at least ½-inch and secured to the downstream liner by means of a welding strip. The 4-inch liner flap extending beyond the spigot end of pipe shall be devoid of locking extensions and shall be protected from damage during pipe handling and jointing operations. Excessive tension and distortion in the flap caused by bending it back sharply at the end of the pipe will not be permitted. Transverse flaps on extruded sheet shall be as specified herein.

Any flap which has been bent and held back during pipe laying and jointing operations shall be allowed to return to its original shape and flatness well in advance of making the liner joint.

For beveled pipe, the liner extension at the spigot end of the pipe shall be trimmed to extend 4-inches beyond and parallel to the beveled end. Length between ends of locking extensions shall not exceed 4-inches.

Field joints in liner at pipe joints shall not be made until the mortar in the pipe has been allowed to cure for at least 48 hours.

All joints between lined pipe and lined cast-in-place structures shall be either Type C-1 or Type C-2 as specified herein.

6. Welding Strips: Welding strips shall be fusion welded to joint strips and liner by qualified welders. The welding operation of any joint shall be continuous until that joint has been completed.

7. Joint Reinforcement: A 12-inch long welding strip shall be applied as reinforcement across each transverse joint and weep channel in liner which extends to the lower terminal edge of liner on each side of a pipe or structure. These reinforcement strips shall be centered over the joint being reinforced and located as close to the lower edge of liner as practicable. After the transverse welding strips have been tested and the test tabs removed, the welding strips shall be welded into place.

8. Special Terminations: Special terminations shall be provided at sluice and slide gate frames, manholes, pipe sleeves, and at other such locations in structures to receive plastic liner. Bonding agents shall be used to seal edges where plastic-liner joins metal items which are cast in the concrete. Surfaces to be bonded shall be thoroughly cleaned. Mixing and application of bonding agents shall be in accordance with the manufacturer's instructions.

## D. Liner Protection and Repair

1. General: Care shall be taken to prevent damage to liner from equipment and materials used in, or taken through, the work. Damage to the installed liner shall be repaired in accordance with the following:

2. Repair Methods: Nail and tie holes and cut, torn, and abraded areas in the liner shall be patched. Patches made entirely with welding strip shall be fused to the liner over the entire patch. The use of this method is limited to patches which can be made with a single welding strip. Do not use parallel, overlapping, or adjoining welding strip. Parallel, overlapping, or adjoining welding strips shall not be used. Larger patches may consist of smooth liner over the damaged area with edges covered with welding strips fused to the patch and to the liner adjoining the damaged area. The size of a single patch of the latter type shall be limited only as to its width, which shall not exceed 4-inches.

## E. Concrete Operations

1. Concrete Vibration: Concrete placed against liner shall be vibrated in a manner so as to avoid damage to the liner and to produce a dense, homogeneous concrete securely anchoring the locking extensions in the concrete. External vibrators may be used in addition to internal vibrators, particularly along the lower edge of plastic liner.

2. Stiffeners: If stiffeners are used along locking extensions of liner installed in forms for pipe, the stiffeners shall be completely withdrawn during the placement of concrete in the forms. The concrete shall be revibrated to consolidate the concrete in the void spaces caused by the withdrawal of the stiffeners.

3. Form Removal: The liner shall be protected from damage during form removal. Sharp instruments shall not be used to pry forms from lined surfaces. When forms are removed, any nails that remain in the liner shall be removed without tearing the liner, and the resulting holes shall be clearly marked. Form tie holes shall be marked before ties are broken off. Areas of serious abrasion of the liner shall be marked. Marked areas and holes shall be repaired in accordance with Part D of this Section.

4. Banding Strap Removal: Banding straps used in securing liner to forms for pipe and cast-in-place structures within the limits of the unlined invert shall be removed. Voids left in the invert at the edge of the liner shall be filled with cement mortar.

## F. Non-Skid Surfaces

Surfaces of liner shown on the plans to be non-skid shall be treated as follows:

1. Surface Cleaning and Adhesive Application: After corner and welding strips have been installed, the surface of the liner shall be cleaned, dried, and sprayed with an adhesive coating recommended by the manufacturer of the liner.

2. Sand Application: The surface shall be liberally sprinkled with clean, dry, well-graded sand which will pass a No. 30 sieve but be retained on a No. 70 sieve.

3. Cleanup: After the sanded surface has thoroughly dried, all excess sand shall be brushed away and a seal coat applied to bond the sand to the liner. The seal coat shall be compatible with the plastic liner. The coated sand surface shall be allowed to dry thoroughly before walking thereon is permitted.

## G. Field Testing

1. Spark Testing: Upon completion of the installation, the surface of the liner shall be cleaned to permit visual inspection and spark testing by the District's Representative, using a spark-type detector, supplied by the Contractor, complying with the requirements of factory testing herein. Areas of liner plate failing to meet the field test shall be repaired and retested. To assist the District with the inspection and spark testing of the liner, ventilation, ladders for access, barricades, or other traffic control devices shall be provided, and entrances and exits shall be opened and closed.

2. Pull Testing: Each transverse welding strip which extends to a lower edge of the liner shall be tested. The welding strips shall extend below the liner providing a tab. A 10-pound pull shall be applied normal to the face of the structure by means of a spring balance. Liner adjoining the welding strip shall be held against the concrete during application of the force. The 10-pound pull shall be maintained if a weld failure develops or until no further separation occurs. Defective welds shall be retested after repairs have been made. Tabs shall be trimmed away neatly after the welding strip has passed inspection. Equipment shall be provided to test liner in the manner recommended by the manufacturer and as described above. Personnel qualified to perform the testing shall be provided by the Contractor. Testing shall be performed in the presence of the District's Representative.

## H. Clean-Up

Before acceptance of the installed liner by the District, the liner shall be cleaned to the satisfaction of the District's Representative.

**END OF SECTION**

# SECTION 09900

# PAINTING AND COATING

## PART 1 - GENERAL

### A. Description

This section describes materials and application of painting and coating systems for submerged metal surfaces, exposed metal surfaces, buried metal surfaces, and metal surfaces in contact with concrete.

### B. Related Work Specified Elsewhere

1. Structural Steel and Miscellaneous Metalwork: 05120
2. Air Release and Vacuum Relief Valves: 15089
3. Manual Valves: 15100
4. Fire Hydrants: 15139
5. Flexible Pipe Couplings and Expansion Joints: 15162
6. Cathodic Protection and Joint Bonding: 16640

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300 and the following.
2. Submit manufacturer's data sheets showing the following information:
    a. Recommended surface preparation.
    b. Dry-film thicknesses per coat for prime, intermediate, and finish coats.
    c. Percent solids by volume.
    d. Recommended thinners.
    e. Statement that the selected prime coat is recommended by the manufacturer for use with the selected intermediate and finish coats.

f. Application instructions including recommended application, equipment, humidity, and temperature limitations and Material Safety Data Sheets (MSDS).

g. NSF or UL certifications of coatings for use in potable water supply systems.

h. Volatile Organic Compound (VOC) limitations

3. Submit certification that all coatings conform to South Coast Air Quality Management District Rules and Regulations for products and application.

## D. Quality Assurance

1. All work shall be accomplished by skilled craftsmen qualified to accomplish required work in a manner comparable with the best standards of practice.

2. A representative from the manufacturer shall be onsite to confirm proper application procedures per manufacturer's specifications.

# PART 2 - MATERIALS

## A. Color System for Coatings

Unless noted otherwise, colors for surfaces that are to be coated shall be defined as follows:

| Color | Pantone ID No. (closest match in sunlight) | Ameron Color System | Miscellaneous Color System |
|---|---|---|---|
| Light Blue | 298C | BL-4 Light Blue | |
| Dark Blue | 2945C | BL-2 Deep Blue | |
| Beige | | 1600 Clay Tan | Carboline:<br>Dunn Edwards<br>DE6128 Sand Dune |
| Gray | 429C | 2973 Light Gray | |
| Light Green | 577C | GN-5 Haze Green | |
| Safety Green | 348U | GN-6 Safety Green | |
| Safety Red | 1797C | RD-1 Bright Red | |
| Safety Yellow | 108U | YE-3 Safety Yellow | |
| Factory Finish | N/A | No Color Coating | |
| White | N/A | WH-1 Standard White | |

## B. Submerged Metal Coating Systems

1. System No. B-1--Submerged Metal, Raw Water or Raw Sewage

Type: Coal-tar epoxy having a minimum volume solids of 70%, conforming to MIL-PRF-23236.

Service Conditions: Shall be used on metal structures or pipes (such as tanks, clarifier mechanisms, scum troughs, slide gates and other miscellaneous metal) submerged in raw water or raw sewage.

Apply a two-coat system to achieve a total dry-film thickness per manufacturer's specification. Approved products include include:

Kop-coat Bitumastic 300-M;
Ameron Amercoat 78 HB;
Tnemec 46H-413
or for contracts between District and Contractor, approved equal.

2. System No. B-2--Submerged Metal, Potable Water

Type: Two part epoxy-polyamide having a minimum volume solids content of 54 ± 2%, or two-part amido-amine epoxy having a minimum volume solids content of 83%.

Service Conditions: Shall be used on structural steel, tank interiors and piping exposed to fresh potable water.

Performance Requirement: Coating materials used in conjunction with potable water supply systems shall be listed by the NSF International as in compliance with NSF Standard 61 or certified to UL 3P83.

Apply a three-coat system to achieve a total dry-film thickness per manufacturer's specification. Approved products include:

Tnemec Series 20, or Series L140F Pota Pox II;
Kop-coat Super Hi-gard Epoxy;
Ameron Amerlock 400 Epoxy;
International Interline 785 HS;
or for contracts between District and Contractor, approved equal.

## C. Exposed Metal Coating Systems

1. System No. C-1--Exposed Metal, Wet Environment

Type: Inorganic zinc prime coat with polyamide cured epoxy paint finish coat.

Service Conditions: Shall be used on metal structures, piping, fittings, and appurtenances subjected to continuous water condensation, or occasional immersion or splashing. Apply a four-coat system;

Apply a four-coat system to achieve a total dry-film thickness per manufacturer's specification. Approved products include:

Kop-coat Hi-gard;
Ameron Amerlock 400 Epoxy;
Tnemec Series 69 Hi-build Epoxoline II;
International Interseal 670 HS;
Devoe Devran 224HS;
or for contracts between District and Contractor, approved equal.

2. System No. C-2--Exposed Metal, Atmospheric Weathering Environment and Exposed Ductile Iron

Type: Aliphatic Polyurethane having a minimum volume solids content of 73% with amido-amine epoxy primer.

Service Conditions: Shall be used on exterior steel (subject to sunlight and weathering) and exposed ductile iron piping, fittings, and appurtenances.

Apply a two-coat system to achieve a total dry-film thickness per manufacturer's specification. Approved products for finish coats include:

Devoe Devran 224HS
Ameron Amershield;
Tnemec Series 75 Endura-shield;
International Interthane 870;
or for contracts between District and Contractor, approved equal,

3. System No. C-3--Exposed Non-ferrous Metal and Galvanized Steel

Type: High solids epoxy coating having a minimum volume solids of 83%, with aliphatic polyurethane finish coat having a minimum volume solids of 73%.

Service Conditions: Shall be used to coat non-ferrous and galvanized steel pipe, fittings, and appurtenances.

Apply a two-coat system to achieve a total dry-film thickness per manufacturer's specification. Approved products include:

Tnemec Series 75 Endura-Shield;
Ameron Amershield;
International Interthane 870;
or for contracts between District and Contractor, approved equal.

**D. Buried Metal Coating Systems**

1. System No. D-1--Buried Metal, Corrosive Groundwater Exposure

Type: Coal-tar epoxy having a minimum volume solids of 78% and complying with MIL-P-23236.

Service Conditions: Shall be used to coat buried metal (flanges, bolts and nuts, fittings, flexible pipe couplings, structural steel etc.) especially subject to corrosive groundwater (low pH, high sulfate and chloride concentrations).

Apply a three-coat system to achieve a total dry-film thickness per manufacturer's specification. Approved products include:

Kop-coat 300-M;
Ameron Amercoat 78 HB;
Tnemec 46H-413 Tneme-Tar;
International Intertuf 132;
or for contracts between District and Contractor, approved equal.

2. System No. D-2--Buried Metal, Non-Corrosive Soil Exposure

Type: High solids epoxy coating having a minimum volume solids of 83%.

Service Conditions: Shall be used to coat buried metal (flanges, fittings, flexible pipe couplings, etc.) subject to non-corrosive soil conditions (neutral pH, low sulfate and chloride concentrations).

Apply a two-coat system to achieve a total dry-film thickness per manufacturer's specification. Approved products include:

Devoe Devran 224HS
Ameron Amershield;
Tnemec Series 75 Endura-shield;
International Interthane 870;
or for contracts between District and Contractor, approved equal,

## E. Coating System for Metal in Contact with Concrete

1. System No. E-1--Aluminum and Concrete Insulation

Type: Bituminous paint having a minimum volume solids of 68% coal-tar pitch based.

Service Conditions: Shall be used to coat areas of aluminum grating, gates, stairs, or structural members in contact with concrete.

Apply a three-coat system to achieve a total dry-film thickness per manufacturer's specification. Approved products for finish coats include:

Kop-coat Bitumastic Super Service Black;
Tnemec 46-465 Tnemecol;
International Intertuf 100;
or for contracts between District and Contractor, approved equal.

## F. PVC Pipe Coating System

1. System No. F-1--Exposed PVC Pipe

Type: High solids Epoxy coating having a minimum volume solids of 83%.

Service Conditions: Shall be used to coat exposed PVC piping in pump stations.

Apply one coat to achieve dry-film thickness per manufacturer's specification. Approved products include:

Ameron Amerlock 400 Epoxy;
International Interseal 670 HS;
Kop-coat Hi-gard Epoxy;
Tnemec Series 69 Hi-build Expoxoline II;
or for contracts between District and Contractor, approved equal.

## G. Valve Coating System

1. System No. G-1--Interior and Exterior Surfaces of Ferrous-Metal Valves

Type: Thermosetting powdered (fusion bonded) epoxy coating.

Service Conditions: Shall be used to coat exterior and interior surfaces of ferrous metal valves, excluding seating areas and bronze and stainless steel pieces.

Apply one coat to achieve dry-film thickness per manufacturer's specification. Approved products include:

3M Scotchkote 134;
or for contracts between District and Contractor, approved equal.

## H. Air Quality Requirements

Materials shall comply with South Coast Air Quality Management District's Rule 1107 for shop coating and Rule 1113 for field coating.

## PART 3 - EXECUTION

## A. Surface Preparation

1. General: All surface preparation and application shall be per manufacturer's product data sheet. Sandblast or prepare only as much surface area as can be coated in one day. All sharp edges, burrs, and weld spatter shall be removed. Epoxy-coated pipe that has been factory coated shall not be sandblasted.

2. SSPC Specifications: 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 SP SET (Surface Preparation Specification and Practices) specifications listed below:

| | |
|---|---|
| SP-1 | Solvent Cleaning |
| SP-2 | Hand Tool Cleaning |
| SP-3 | Power Tool Cleaning |
| SP-5 | White Metal Blast Cleaning |
| SP-6 | Commercial Blast Cleaning |
| SP-7 | Brush-Off Blast Cleaning |
| SP-8 | Pickling |
| SP-10 | Near White Blast Cleaning |

3. Sandblasting: The Contractor shall provide suitable enclosure, exhaust system, and bag house for sandblasting operations to prevent violations of applicable air quality requirements.

## B. Painting Systems

All paints shall be delivered to the jobsite in the original, unopened containers. All materials of a specified painting system, including primer, intermediate, and finish coats, shall be produced by the same manufacturer. Thinners, cleaners, driers, and other additives shall be as recommended by the paint manufacturer for the particular coating system.

## C. Paint Mixing

Multiple-component coatings shall be prepared using all the contents of each component container as packaged by the paint manufacturer. Partial batches shall not be used. Multiple-component coatings that have been mixed beyond their pot life shall not be used. Small quantity kits for touch-up painting and for painting other small areas shall be provided. Only the components specified and furnished by the paint manufacturer shall be mixed. For reasons of color or otherwise, additional components shall not be intermixed, even within the same generic type of coating.

## D. Surfaces Not To Be Painted

Unless noted otherwise, the following surfaces shall not be painted and shall be fully protected when adjacent areas are painted.

1. Mortar-coated pipe and fittings
2. Stainless Steel
3. Metal letters
4. Nameplates and grease fittings
5. Aluminum grating
6. Brass and copper tubing, submerged
7. Buried pipe, unless specifically required in the piping specifications

## E. Protection of Surfaces Not To Be Painted

Hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted shall be removed, masked, or otherwise protected. Drop cloths shall be provided to prevent paint materials from falling on or marring adjacent surfaces. Working parts of mechanical and electrical equipment shall be protected from damage during surface preparation and painting process. Openings in motors shall be safely masked to prevent paint and other materials from entering the motors. All masking materials shall be completely removed and surfaces cleaned at completion of painting operations.

## F. Surfaces To Be Coated

Surfaces shall be coated as described below:

1. Above Ground and Exposed Piping: Above ground and exposed piping or piping in vaults and structures shall be coated as described in the various piping specifications and as specified herein. Color shall be as specified herein or as required by the District's Representative.

2. Valves: Valves shall be coated as described in the various valve specifications. Above ground valves, or valves in vaults and structures, shall match the color of the connecting piping.

3. Buried Items: Buried flanges, nuts and bolts, valves, flexible pipe couplings, exposed rebar from thrust blocks, and valve boxes shall be coated per System No. D-1 unless otherwise specified in the particular specifications for these items.

4. Above Ground Structural Steel and Structural Steel in Vaults: Above ground structural steel or structural steel located in vaults and structures shall be coated as described in the exposed metal coating system section.

5. Pipe Supports: Pipe supports in vaults shall be coated the same as the adjacent piping. If pipe is PVC, pipe supports shall be coated per System No. C-1.

6. Exposed Indoor Galvanized Electrical Conduit: Exposed indoor galvanized electrical conduit shall be coated per System No. C-3. Color of finish coat shall be OSHA Safety Orange.

7. Mechanical Equipment: Mechanical equipment, such as pumps, shall be coated in accordance with System C-3.

8. Aluminum in Contact with Concrete: Aluminum surfaces in contact with concrete shall be coated per System No. E-1.

## G. Color Schedule

1. Color Guidelines: Unless noted otherwise, surfaces that are to be coated and which require a color designation for any of the following uses, shall be coated to match the colors listed below.

2. Definitions:

   At Grade (AtG): Facilities that are flush with streets, sidewalks, parking lots, green belts or graded areas.

   Above Grade/Exposed (AG/E): Pipelines and other facilities that are protruding through and are located above finished grade, out of doors and not enclosed by a shelter, cover, vault or housing.

Enclosed (E): Pipeline and other facilities that are located above or below grade and are enclosed within a shelter, covers, or vaults.

3. Water System:

| **Facility** | **Color** |
|---|---|
| Airvac Assemblies | Factory Finish |
| Airvac Covers | Factory Finish-granite |
| Air Vents | ANSI 61 Gray |
| Electric Enclosures | ANSI 61 Gray |
| Electric Motors | Cylinder Cream SW4005 |
| Fire Hydrants | Caterpillar Yellow 3119 |
| Guard Posts | Caterpillar Yellow 3119 |
| Meter Box Lids | Factory Finish |
| Piping | Cylinder Cream SW4005 |
| Pressure Vessels | Cylinder Cream SW4005 |
| Pump & Pump Bases | Cylinder Cream SW4005 |
| Valve Can Lids | Factory Finish |
| Fire Hydrant Valve Can Lids | Factory Finish |
| Valves Exposed (all types) | Cylinder Cream SW4005 |
| Vault Hatch Lids | Factory Finish |
| Sampling Station Enclosures | Gray Factory Finish |

* Paint colors listed are Sherwin-Williams coded colors. An equivalent color by another manufacturer can be substituted with District approval. Final color selection shall be determined by the District representative.

4. Identification (I.D.) Mark:

Certain facilities listed above to be coated shall have an identification system applied by the contractor at the District's direction.

Vault hatches (coated or uncoated) shall be identified with the YLWD initials and the system the facility serves (potable water or sewer). The identification mark shall be able to stand up to traffic and not pose a tripping hazard.

Other facilities listed above that are to be coated and/or provided with an I.D. mark shall receive a District supplied identification decal that consists of the District's logo, phone number, system identification color, and the system the facility serves.

## H. Field Touch Up of Shop-Applied Prime Coats

Field touch up shall be determined on a case by case per product manufacturer's recommendations based on surrounding conditions.

## I. Dry-Film Thickness Testing

1. Coating Thickness Testing: Coating thickness specified for steel surfaces shall be measured with a magnetic-type dry-film thickness gage. Dry-film thickness gage shall be provided as manufactured by Mikrotest or Elcometer. Each coat shall be checked for the correct dry-film thickness. Measurement shall not be made until coating has fully cured per manufacturer's specifications and a minimum of eight hours after application of the coating. Non-magnetic surfaces shall be checked for coating thickness by micrometer measurement of cut and removed coupons. Contractor shall repair coating at all locations where coupons are removed.
2. Holiday Testing: The finish coat (except zinc primer and galvanizing) shall be tested for holidays and discontinuities with an electrical holiday detector of the low-voltage, wet-sponge type. Detector shall be provided as manufactured by Tinker and Rasor or K-D Bird Dog.

3. Repair: If the item has an improper finish color, insufficient film thickness, or holidays, the surface shall be cleaned and top-coated 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**

# SECTION 15041

# CHLORINATION OF WATER FACILITIES FOR DISINFECTION

## PART 1 - GENERAL

### A. Description

This section describes the disinfection of potable water mains, services, appurtenances, and connections by chlorination, in accordance with ANSI/AWWA B300, B301, C651 and C652 and as specified herein.

### B. Related Work Specified Elsewhere

Hydrostatic Testing of Pressure Pipelines: 15042

### C. Job Conditions

1. Discharge of chlorinated water into watercourses or surface waters is regulated by the National Pollutant Discharge Elimination System (NPDES). Contractor shall procure an NPDES permit prior to beginning of work.

2. The rate of flow and locations of discharges shall be scheduled in advance to permit review and coordination with District and corresponding regulatory authorities.

    a. Orange County Flood Control District.

    b. Cities of Yorba Linda, Placentia, Anaheim, Brea, and portions of unincorporated County of Orange.

3. Potable water shall be used for chlorination.

4. Requests for use of water from District waterlines shall be submitted 48 hours in advance.

5. Chlorination shall be performed after hydrostatic testing for pipelines having a diameter of 12-inches and larger. See Part 3, Paragraph A-9 for concurrent testing of smaller diameter pipelines.

## PART 2 - MATERIALS

### A. Liquid Chlorine Solution

Liquid chlorine solution shall be in accordance with the requirements of ANSI/AWWA B301, and shall be injected with a solution feed chlorinator and a water booster pump or a sufficiently pressurized source of water to provide an adequate flow to inject and disperse the chlorine solution.

### B. Calcium Hypochlorite (Granules)

Calcium Hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300, and shall be dissolved in water to a known concentration in a container and pumped into the pipeline at a measured rate.

### C. Sodium Hypochlorite (Solution)

Sodium Hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300, and shall be diluted in water to desired concentration and pumped into the pipeline at a measured rate.

### D. Calcium Hypochlorite Tablets and Adhesive

1. Chlorine Content: The tablets shall have an average weight of 5 grams each and shall contain not less than 70% of available chlorine.

2. Adhesive: Adhesive shall be a type that will not impart taste, odor, or detrimental compounds to the water supply, and shall be NSF approved for use in drinking water.

3. Storage: Proper care shall be taken to store hypochlorite tablets in tightly closed containers where they will not be accessible to children or unauthorized persons.

### E. Chlorine Residual Test Kit

For measuring chlorine concentration, a medium range, drop count, titration kit or an orthotolidine indicator comparator with wide range color discs shall be used. The kit shall be capable of determining chlorine concentration in the range 1.0 to 25 mg/L. Test kits shall be Hach Chemical, Hellige, or for contracts between District and Contractor, approved equal. An adequate number of kits shall be maintained by the Contractor in good working order and available for immediate test of residuals at points of sampling.

## PART 3 - EXECUTION

## A. PIPELINES

1. General: Before being placed into service, all pipelines and appurtenances shall be chlorinated. Pipeline tie-ins shall occur within maximum two weeks after disinfection. Otherwise, pipelines shall be disinfected again prior to the tie-in.

   Pipelines with a diameter of 10-inches or less shall be disinfected by either direct chlorine solution injection or by use of calcium hypochlorite tablets. Pipelines with a diameter of 12-inches and larger shall be disinfected by direct chlorine solution injection. Steel pipelines shall be disinfected by direct chlorine solution injection. Bacteriological testing after disinfection shall be performed by the District or District approved laboratory.

2. Chlorination Contractor: Chlorination shall be performed by a certified chlorination and testing Contractor. Chlorination shall be in accordance with the instructions of the chlorinator manufacturer.

3. Groundwater: In the event groundwater is encountered and it is impossible to prevent its entrance into the mains, or the mains are not free from dirt, they shall be thoroughly flushed prior to disinfection. Disinfection shall be by direct chlorine solution injection.

4. Services: Every service connection served by a main being disinfected shall be tightly shutoff at the curb stop before water is applied to the main. Care shall be taken to expel all air from the main and services during the filling operation.

5. Pipeline Flushing:

   Before chlorinating pipeline, flush pipes with water to remove dirt and debris. Maintain a flushing velocity of at least 3 feet per second. Flush pipes for a minimum of the time period calculated from the formula:

   $T = \frac{2}{3}L$ in which:

   T = flushing time in seconds
   L = pipe length in feet

   If a velocity of 3 feet per second cannot be achieved, other methods of cleaning as recommended by AWWA C651 may be selected by the District at no additional cost.

6. Chlorine Solution Injection by the Continuous Feed Method:

   a. Chlorine solution shall be applied by means of a vacuum-operated chlorinator and a booster pump or a sufficiently pressurized source of water to provide an adequate flow to operate the eductor system and properly disperse the chlorine solution. Direct-feed chlorinators, which operate from gas pressure in the chlorine cylinder, without a vacuum regulator, shall not be used for application of a chlorine solution.

   b. Chlorine solution shall be applied at the beginning of the section to be chlorinated and shall be injected through a corporation stop, a hydrant, or other approved connection to ensure treatment of the entire system being disinfected. All required corporation stops and other plumbing materials necessary for chlorination or flushing of the main shall be installed by the Contractor.

   c. Potable water shall be introduced into the pipeline at a constant measured rate. Chlorine solution shall be injected into the potable feed water at a measured rate. The two rates shall be proportioned so that the chlorine concentration in the pipeline is maintained at a minimum concentration of 50 mg/L to 100 mg/L, with a chlorine residual of 25 mg/L after 24 hours in the pipe. The concentration at points downstream shall be checked periodically during the filling to ascertain that sufficient chlorine is being added.

7. Disinfection by Calcium Hypochlorite Tablets: The use of calcium hypochlorite tablets will be permitted in pipe sizes 4- through 10-inches. The tablets shall be attached by means of an approved adhesive to the inside top of the lengths of pipe as they are being laid. The amount of adhesive shall be limited to the smallest practicable amount applied to one side of the tablet only

   The following table shows the number of tablets to be used per length of pipe of various sizes to provide the required chlorine residual:

| Inside Diameter of Pipe (Inches) | No. of 5g. Hypochlorite Tablets Per Length of Pipe, in feet | | |
|---|---|---|---|
| | 10 | 18 & 20 | 40 |
| 4 | 1 | 1 | 1 |
| 6 | 1 | 1 | 2 |
| 8 | 1 | 2 | 4 |
| 10 | 2 | 3 | 5 |

   For unusual pipe lengths, use the following equation to calculate the number of 5g hypochlorite tablets required, rounded up:

   # of 5g hypochlorite tablets = $0.0012d^2L$

Where d = inside pipe diameter in inches
L = pipe length in feet

8. Disinfection of Valves and Appurtenances: During the period that the chlorine solution or slug is in the section of pipeline, valves shall be opened and closed to obtain a chlorine residual at hydrants and other pipeline appurtenances. Care shall be taken to ensure that no chlorinated water enters any active pipeline.

9. Concurrent Testing (for Pipelines with Diameter of 10-inches or Less): Disinfecting mains and appurtenances, and hydrostatic testing may run concurrently for the required 24-hour test period. In the event there is leakage and repairs are necessary, disinfection of the pipeline shall be repeated by injection of chlorine solution into the line as provided in this section.

10. Confirmation of Residual: After the chlorine solution applied by the continuous feed method has been retained in the pipeline for 24 hours, samples shall be taken at air valves and other points of access to confirm that a chlorine residual of 25 mg/L minimum exists along the pipeline.

    With the slug method, samples shall be taken as the slug passes each access point and as it leaves the pipeline in order to confirm that a chlorine residual of 25 mg/L minimum is present.

11. Pipeline Flushing and Dechlorination: After confirming the chlorine residual, excess chlorine solution shall be flushed from the pipeline until the chlorine concentration in the water leaving the pipe is within 0.5 mg/L of the replacement water. Dechlorination chemicals or tablets shall be used to neutralize the excess chlorine solution prior to flushing into the storm drain. This may require a permit from the regulatory agency. Flushing into the sewer system is strictly prohibited.

12. Bacteriologic Tests: After final flushing, two consecutive sets of acceptable samples shall be collected, with the first set taken after filling the new pipeline with fresh system water, and the second set taken at least 16 hours later. The location and quantity of samples shall be determined by the District. The samples shall be delivered to an independent laboratory within six hours. A bacteriologic quality test will be performed by the laboratory, and test results shall be delivered to the District to demonstrate the absence of coliform organisms and a plate count of less than 200, in each separate section of the pipeline after chlorination and refilling.

13. Repetition of Procedure: If the initial chlorination fails to produce required residuals and bacteriologic tests, chlorination and testing shall be repeated until satisfactory results are obtained.

14. Test Facility Removal**:** After satisfactory disinfection, air valves shall be replaced, the pipe coating restored, and temporary disinfection and test facilities removed.

## B. WELLS AND WELL-HEAD PUMP STATIONS

1. General: The well and well head piping shall be disinfected as a complete unit. Adequate bracing shall be provided to resist thrust.

2. Depth of Disinfection: The well shall be disinfected to its full depth. A double capped, perforated pipe container filled with granular chlorine compound shall be moved up and down the entire water-filled casing and screen section until all the chlorine compound has dissolved.

3. Pump Column Disinfection: The pump column shall be washed with a chlorine solution, containing at least 12 percent chlorine, as the pump column is lowered into the well or pump can.

4. Mixing: After the well pump has been placed into position, it shall be turned on and off several times so as to thoroughly mix the disinfectant with the water in the well. The flow control valve shall be set at a pumping rate of 2 cfs. The pump shall run until the water discharged has the odor of chlorine. This procedure shall be repeated several times at one-hour intervals.

5. Disinfection Time: After mixing, the well shall be allowed to stand without pumping for 24 hours.

6. Flushing: Well water shall be pumped to waste until the presence of chlorine is no longer detectable, as determined by testing for available chlorine residual using a test kit. Allow the well to stand without pumping for 24 hours.

7. Bacteriological Tests: On two consecutive days, bacteriological samples shall be taken and submitted to the District's laboratory for examination. Samples shall be tested by the District's laboratory for coliform bacteria and heterotrophic plate count. All coliform test results must be negative and heterotrophic plate counts must be less than 200 colonies/mL prior to placing the well into service.

8. Repetition of Procedure: If the laboratory analysis shows the water is not free of bacterial contamination, the disinfection procedure shall be repeated. Depending on the level of contamination, it may be necessary to use a higher concentration chlorine solution. The water shall then be re-tested. Two consecutive samples must pass the bacteriological tests before the well can be placed in service.

## C. RESERVOIRS

1. General: The Contractor shall make all necessary provisions for conveying water from the District designated supply source to the points of use.

2. Facilities to be Disinfected: All hydraulic structures and appurtenant pressure piping shall be tested; those for potable water shall also be disinfected. In the case of a reservoir, testing and disinfecting operations shall be combined. Disinfection shall be accomplished by chlorination. All chlorinating and testing operations shall be done in the presence of the District Representative.

3. Scheduling: 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 at the time the work is accepted by the District.

4. Bacteriological Testing: Bacteriological testing shall be performed by an independent laboratory. Results of the bacteriological testing shall be satisfactory to the District and the State Department of Public Health or other appropriate regulatory agency. Passing tests on two consecutive days for heterotrophic plate count (<200 cfu/mL) and absence from coliform bacteria must be achieved prior to placing the reservoir into service.

5. Release of Disinfection Water: Release of water from structures, after testing and disinfecting have been completed, shall be acceptable to the District.

6. Preliminary Cleaning and Flushing: Prior to both testing and disinfecting, all hydraulic structures shall be cleaned by thoroughly hosing down all surfaces with a high pressure hose and nozzle of sufficient size to deliver a minimum flow of 50 gpm. All water, dirt, and foreign material accumulated in this cleaning operation shall be discharged from the structure or otherwise removed.

7. Disinfection of Hydraulic Structures and Appurtenant Pipelines: All hydraulic structures which store or convey potable water shall be disinfected by chlorination. Chlorination of hydraulic structures shall be performed in accordance with the requirements of ANSI/AWWA C652.

    a. Chlorination: A strong chlorine solution (about 200 mg/L) shall be sprayed on all interior surfaces of the structure. Following this, the structure shall be partially filled with water to a depth of approximately one foot. During the partial filling operation, a chlorine-water mixture shall be injected by means of a solution feed chlorinating device in such a way as to give a uniform chlorine concentration during the entire filling operation. The point of application shall be such that the chlorine solution will mix readily with the in-flowing water. The dosage applied to the water shall be sufficient to provide a chlorine

residual of at least 50 mg/L upon completion of the partial filling operation. Precaution shall be taken to prevent the strong chlorine solution from flowing back into the lines supplying the water. After the partial filling has been completed, sufficient water shall be drained from the lower ends of appurtenant piping to ensure filling the lines with the heavily chlorinated water.

b. Retention Period: Chlorinated water shall be retained in the partially filled structure and appurtenant piping long enough to destroy all non-spore-forming bacteria, and in any event, for at least 24 hours. After the chlorine-treated water has been retained for the required time, the free chlorine residual in the structure and appurtenant piping shall be at least 25 mg/L. All valves shall be operated while the lines are filled with the heavily chlorinated water.

c. Final Filling of Structure: After the free chlorine residual has been checked, and has been found to satisfy the above requirement, the water level in the structure shall be raised to its final elevation by addition of potable water. Before final filling is commenced, the concentration of heavily-chlorinated water remaining in the structure and piping shall, unless otherwise acceptable to the District's representative, be sufficient to produce a free chlorine residual of between 1 and 2 mg/L when the water level is raised to its final elevation. After the structures have been filled, the strength of the chlorinated water shall be determined. If the free chlorine residual is less than one mg/L, an additional dosage shall be applied to the water in the structure. If the free chlorine residual is greater than 2 mg/L, the structure shall be partially emptied and additional potable water added. In no case shall water be released prior to the expiration of the required retention period.

8. Connections to Existing System: Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a one percent hypochlorite solution before they are installed. Thorough flushing shall be started as soon as the connection is completed and shall be continued until all discolored water is eliminated.

**END OF SECTION**

# SECTION 15042

# HYDROSTATIC TESTING OF PRESSURE PIPELINES

## PART 1 - GENERAL

### A. Description

This section describes pressure and leakage testing of all pressure pipelines, in accordance with ANSI/AWWA C600 and as specified herein.

### B. Related Work Specified Elsewhere

Chlorination of Water Mains for Disinfection: 15041

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300 and the following.

2. Test bulkhead locations and design calculations, pipe attachment details, and methods to prevent excessive pipe wall stresses.

### D. Job Conditions

1. For potable water pipelines, obtain and use only potable water for hydrostatic testing. See Special Provision Section for availability of water.

2. Submit request for use of District water to the District 48 hours in advance.

3. Hydrostatic testing shall be successfully completed before new pipelines are connected to existing District pipes and mains.

### E. Testing Company

All testing shall be performed by an independent certified District-approved testing company or as called out in the project plans, specifications and contract documents. The testing company will be required to provide the District Representative with certified testing results. Testing company shall provide gauges and meters which have been calibrated and certified annually.

## PART 2 - MATERIALS

### A. Test Bulkheads

Test bulkheads shall be designed and tested in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code. Materials shall comply with Part UCS of said code. Bulkhead design pressure shall be at least 2.0 times the specified test pressure for the section of pipe containing the bulkhead. Stress shall be limited to 70% of yield strength of the bulkhead material at the bulkhead design pressure. Air-release and water drainage connections shall be included.

### B. Manual Air-Release Valves

Temporary manual air-release valves shall be provided as necessary for pipeline test. The pipe outlet shall be constructed in the same manner as for a permanent air valve and after use, sealed with a blind flange, pipe cap, or plug and coated equal to the adjacent pipe.

### C. Water

The same water used for chlorination of the pipeline may be used to fill the line for testing. Make up water for testing potable water pipelines shall be potable water.

## PART 3 - EXECUTION

### A. General

All labor, materials, tools, and equipment for testing shall be furnished by the Contractor. The test shall be conducted with valves in the test section open. Ends of each test section, open ends of pipes, valves, and fittings shall be suitably closed. Valves in the test section shall be operated during the test period.

### B. Testing and Disinfection Sequence

See Section 15041, Chlorination for Disinfection of Water Mains.

### C. Isolation of Test Pipe Section from Existing Potable Water Pipelines

Test bulkheads, valves, connections to existing pipelines, and other appurtenances shall be located and installed in a manner to provide air gap separation between existing potable water pipelines and pipeline being tested.

## D. Length of Test Section

The maximum length of test section for pipe of 12-inches or smaller in diameter shall be 3,500 feet; for pipe larger than 12-inches, 1 mile. Test bulkheads shall be provided where the distance between valves exceeds these limits.

## E. Requirements Prior to Testing

1. Backfill: The pipe trench shall be backfilled with a minimum of 2 1/2 feet of material, or center loaded to hold the pipe in place while testing.

2. Concrete Anchor and Thrust Blocks: All concrete anchor blocks shall be allowed to cure a sufficient time to develop the designed minimum strength before testing.

3. Mortar Lining: Steel pipelines shall not be tested before the mortar lining and coating on all of the pipe lengths in the line have attained an age of 14 days. Cement-mortar lined pipe shall not be filled with water until a minimum period of eight hours has elapsed after the last joint in any section has been made.

4. Flushing: All pipelines shall be blown out or flushed out using a flushing ball or pig.

## F. Field Test Procedure

1. Filling Rate: The pipeline shall be filled at a rate such that the average velocity of flow is no greater than 1 fps. At no time shall the maximum velocity of flow exceed 2 fps. The following table relates velocity filling rate to an equivalent volume flow rate for pipe diameters 10-inches and under.

Filling Rates in gpm
Equivalent to Filling Velocities of 1 fps, for Pipes Flowing Full

| Nominal Size (inches) | Flow Rate Q (gpm) |
|---|---|
| 4 | 9.8 |
| 6 | 14.7 |
| 8 | 19.6 |
| 10 | 24.5 |

2. Air Removal: All air should be purged from the pipeline before checking for leaks or performing pressure tests on the system. To accomplish this, if air valves or hydrants or other outlets are not available at high points, taps shall be made to expel the air, and these taps shall be tightly plugged after testing.

3. Pressurization: After the pipeline has been filled and allowed to sit a minimum of 48 hours (72 hours for mortar-lined pipelines), the pressure in the pipeline

shall then be pumped up to the specified test pressure. If a large quantity of water is required to increase the pressure during testing, entrapped air, leakage at joints, or a broken pipe may be suspected. TESTS SHOULD BE DISCONTINUED until the source of trouble is identified and corrected.

4. Field Test Pressure: Unless otherwise specified, the pipeline shall be subjected to a field hydrostatic pressure of 200 psi for Class 305 PVC pipe, and 125% of design pressure for steel pipe, but not to exceed 200 psi.

## G. Allowable Leakage

1. Pipelines of Diameter 10-inches and Under:

   a. When the test pressure has been reached, pumping shall be discontinued until the pressure in the line has dropped 5 psi, at which time the pressure shall again be pumped up to the specified test pressure. This procedure shall be repeated until four hours have elapsed from the time the specified test pressure was first applied. At the end of the four-hour period, the pressure shall be pumped up to the test pressure for the last time.

   b. The leakage shall be considered as the total amount of water pumped into the pipeline during the four-hour period, including the amount required in reaching the test pressure for the final time. The following table indicates the leakage allowance for various sizes of pipe and is equal to the number of gallons per the four-hour test per 1,000 feet of pipe being testing:

**LEAKAGE ALLOWANCE**

| Pipe Size (inches) | Allowable leakage for 200 psi Test Pressure (gallons per four hours per 1,000 feet of pipe) | Allowable leakage for 250 psi Test Pressure (gallons per four hours per 1,000 feet of pipe) |
|---|---|---|
| 8 | 0.76 | 0.85 |
| 10 | 0.96 | 1.07 |
| 12 | 1.15 | 1.28 |
| 16 | 1.53 | 1.71 |
| 18 | 1.72 | 1.92 |
| 24 | 2.29 | 2.56 |
| 30 | 2.87 | 3.2 |
| 36 | 3.44 | 3.85 |
| 42 | 4.01 | 4.49 |
| 48 | 4.59 | 5.13 |
| 54 | 5.16 | 5.77 |
| 60 | 5.73 | 6.41 |

c. One to three days shall be allowed for the filled pipeline to soak and to release entrapped air. The test pressure shall be applied with a positive displacement pump. A snubber and dampener shall be provided between the pump and the pipeline to reduce instantaneous pressure pulses to 10% of the specified test pressure. Water shall be drawn through a positive displacement meter.

d. Note the allowable leakage rate for pipeline sections with flanged, welded, and/or grooved-end joints shall be zero.

2. PVC Force Mains and Pipelines of Diameter 12-inches and Larger:

a. The test pressure shall be maintained for a four (4) hour duration by restoring it whenever it falls an amount of 5 psi.

b. The amount of water used to maintain the test pressure during the test period shall be considered the leakage. The allowable leakage shall be determined by the following formula:

$$L = \frac{ND(P)^{1/2}}{7400}$$

where L is the allowable leakage in gallons per hour,
N is the number of rubber-gasketed pipe joints in the test section
D is the inside pipe test diameter in inches,
P is the pipe test pressure (psig), which is defined as the average of the highest and lowest test pressures in the pipe section being tested.

## H. Repetition of Test

If the actual leakage exceeds the allowable, the faulty work shall be located and corrected and the test repeated. The work shall be restored, and all damage resulting from leaks repaired. All visible leakage shall be eliminated.

## I. Bulkhead and Test Facility Removal

After a satisfactory test, water shall be drained, test bulkheads and other test facilities removed, and pipe coatings restored.

**END OF SECTION**

# SECTION 15043

# LEAKAGE AND INFILTRATION TESTING OF NON-PRESSURE PIPELINES

## PART - 1 GENERAL

### A. Description

This section describes the requirements and procedures for leakage and infiltration testing of gravity sewer systems, in accordance with ANSI/ASTM C828, Low Pressure Air Test of Vitrified Clay Pipelines.

### B. Related Work Specified Elsewhere

1. Vitrified Clay Pipe: Section 02710

2. Hydrostatic Testing of Pressure Pipelines: Section 15042

### C. Testing

1. General: All tests shall be made in the presence of the District Representative.

2. Leakage: Each section of sewer between two successive manholes shall be tested for leakage and the leakage test shall be made on all section of sewer.

3. Infiltration: The infiltration test shall be made where excessive groundwater is encountered.

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

5. Other Utilities: Official District tests will not be made until after all the other utilities have been installed and their trench compaction verified.

6. Excessive Leakage or Infiltration: 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 relaid by the Contractor.

7. Acceptance: The sewer will not be accepted until the leakage or infiltration rate, as determined by test, is less than the maximum allowable.

8. Sewer Laterals: When sewer laterals are added after the sewer main has been constructed by connecting to a previously installed wye fitting or to a new saddle fitting, the new sewer lateral shall be plugged at the sewer main by use of a test wye fitting and air tested to the satisfaction of the District Representative. The test wye shall be plugged after passing the air test.

## PART 2 - MATERIALS

The Contractor shall furnish all equipment and materials required for testing.

## PART 3 - EXECUTION

### A. Air Test for VCP Gravity Sewers

1. Test Section: Each section of sewer between two successive manholes shall be tested by plugging all pipe outlets with suitable test plugs.

2. Addition of Air: 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 blowoff valve set at 5 psig to ensure that at no time the internal pressure in the pipe exceeds 5 psig.

3. Internal Pressure: 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.

4. Minimum Time for Allowable Pressure Drop: The time in seconds that is required for the internal air pressure to drop from 3.5 psig to 2.5 psig shall be measured and the results compared with the minimum permissible pressure holding times indicated in the following tables.

5. Retest: If the pressure drop from 3.5 psig to 2.5 psig occurs in less time than specified, the pipe shall be repaired and, if necessary, replaced and relaid until the joints and pipe shall hold satisfactorily under this test.

NATIONAL CLAY PIPE INSTITUTE AIR TEST TABLES

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG

PIPE DIAMETER

(FOR USE WHEN TESTING ONE DIAMETER ONLY)

| LENGTH | 4” | 6” | 8” | 10” | 12” | 15” | 18” | 21” | 24” | 27” | 30” | 33” | 36” | 39” |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 4 | 10 | 18 | 22 | 27 | 32 | 36 | 45 | 54 | 63 | 72 | 81 | 90 | 99 |
| 50 | 9 | 21 | 36 | 45 | 54 | 63 | 72 | 90 | 108 | 126 | 144 | 162 | 180 | 198 |
| 75 | 14 | 32 | 54 | 68 | 81 | 94 | 108 | 135 | 162 | 189 | 216 | 243 | 270 | 297 |
| 100 | 18 | 42 | 72 | 90 | 108 | 126 | 144 | 180 | 216 | 252 | 288 | 324 | 360 | 396 |
| 125 | 22 | 52 | 90 | 112 | 135 | 158 | 180 | 225 | 270 | 315 | 360 | 405 | 450 | 495 |
| 150 | 27 | 63 | 108 | 135 | 162 | 189 | 216 | 270 | 324 | 378 | 432 | 486 | 540 | 594 |
| 175 | 32 | 74 | 126 | 158 | 189 | 220 | 252 | 315 | 378 | 441 | 504 | 567 | 630 | 693 |
| 200 | 36 | 84 | 144 | 180 | 216 | 252 | 288 | 360 | 432 | 504 | 576 | 648 | 720 | 792 |
| 225 | 40 | 94 | 162 | 202 | 243 | 284 | 324 | 405 | 486 | 567 | 648 | 729 | 810 | 891 |
| 250 | 45 | 105 | 180 | 225 | 270 | 315 | 360 | 450 | 540 | 630 | 720 | 729 | 810 | 891 |
| 275 | 50 | 116 | 198 | 248 | 297 | 346 | 396 | 495 | 594 | 693 | 792 | 891 | 990 | 1089 |
| 300 | 54 | 126 | 216 | 270 | 324 | 378 | 432 | 540 | 648 | 756 | 864 | 972 | 1080 | 1188 |
| 350 | 63 | 147 | 252 | 315 | 378 | 441 | 504 | 630 | 756 | 882 | 1008 | 1134 | 1260 | 1386 |
| 400 | 72 | 168 | 288 | 360 | 432 | 504 | 575 | 720 | 864 | 1008 | 1152 | 1296 | 1440 | 1584 |
| 450 | 81 | 189 | 324 | 405 | 486 | 567 | 648 | 810 | 972 | 1134 | 1296 | 1458 | 1620 | 1782 |
| 500 | 90 | 210 | 360 | 450 | 540 | 630 | 720 | 900 | 1080 | 1260 | 1440 | 1620 | 1800 | 1980 |

NATIONAL CLAY PIPE INSTITUTE AIR TEST TABLES

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG

LENGTH OF 6" DIAMETER MAIN LINE IN FEET

| LENGTH OF 4" LATERAL | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 15 | 26 | 36 | 46 | 57 | 68 | 78 | 88 | 99 | 108 | 120 | 130 | 172 | 214 |
| 50 | 20 | 30 | 40 | 51 | 62 | 72 | 82 | 93 | 104 | 114 | 124 | 135 | 177 | 217 |
| 75 | 24 | 34 | 45 | 56 | 66 | 76 | 87 | 98 | 108 | 118 | 129 | 140 | 182 | 224 |
| 100 | 28 | 37 | 50 | 60 | 70 | 81 | 92 | 102 | 112 | 123 | 134 | 144 | 186 | 228 |
| 125 | 33 | 44 | 54 | 64 | 75 | 86 | 96 | 106 | 117 | 128 | 138 | 148 | 190 | 232 |
| 150 | 38 | 48 | 58 | 69 | 80 | 90 | 100 | 111 | 122 | 132 | 142 | 153 | 195 | 237 |
| 175 | 42 | 52 | 63 | 74 | 84 | 94 | 105 | 116 | 126 | 136 | 147 | 158 | 200 | 242 |
| 200 | 46 | 57 | 68 | 78 | 88 | 99 | 110 | 120 | 130 | 141 | 152 | 162 | 204 | 246 |
| 225 | 51 | 62 | 72 | 82 | 93 | 104 | 114 | 124 | 135 | 146 | 156 | 166 | 202 | 250 |
| 250 | 56 | 66 | 76 | 87 | 98 | 108 | 118 | 129 | 140 | 150 | 160 | 171 | 213 | 255 |
| 275 | 60 | 70 | 81 | 92 | 102 | 112 | 123 | 134 | 144 | 154 | 165 | 1769 | 218 | 260 |
| 300 | 64 | 75 | 86 | 96 | 106 | 117 | 128 | 138 | 148 | 159 | 168 | 180 | 222 | 264 |
| 350 | 74 | 84 | 94 | 105 | 176 | 126 | 136 | 147 | 158 | 228 | 238 | 189 | 231 | 273 |
| 400 | 82 | 93 | 104 | 114 | 124 | 135 | 146 | 156 | 166 | 177 | 188 | 198 | 240 | 282 |
| 450 | 92 | 102 | 112 | 123 | 134 | 144 | 154 | 165 | 176 | 186 | 196 | 207 | 249 | 291 |
| 500 | 100 | 111 | 122 | 132 | 142 | 153 | 164 | 174 | 184 | 195 | 206 | 216 | 258 | 300 |

NATIONAL CLAY PIPE INSTITUTE AIR TEST TABLES

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG

LENGTH OF 8" DIAMETER MAIN LINE IN FEET

| LENGTH OF 4" LATERAL | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 22 | 40 | 58 | 76 | 94 | 112 | 130 | 148 | 166 | 184 | 202 | 220 | 292 | 364 |
| 50 | 27 | 45 | 63 | 81 | 99 | 117 | 135 | 153 | 171 | 189 | 207 | 225 | 297 | 369 |
| 75 | 32 | 50 | 68 | 86 | 104 | 122 | 140 | 158 | 176 | 194 | 212 | 230 | 302 | 374 |
| 100 | 36 | 54 | 72 | 90 | 108 | 126 | 144 | 162 | 180 | 198 | 216 | 234 | 306 | 378 |
| 125 | 40 | 58 | 76 | 94 | 112 | 130 | 148 | 166 | 184 | 202 | 220 | 238 | 310 | 382 |
| 150 | 45 | 63 | 81 | 99 | 117 | 135 | 153 | 171 | 189 | 207 | 225 | 243 | 315 | 387 |
| 175 | 50 | 68 | 86 | 104 | 122 | 140 | 158 | 176 | 194 | 212 | 230 | 248 | 320 | 392 |
| 200 | 54 | 72 | 90 | 108 | 126 | 144 | 162 | 180 | 198 | 216 | 234 | 252 | 324 | 396 |
| 225 | 58 | 76 | 94 | 112 | 130 | 148 | 166 | 184 | 202 | 220 | 238 | 256 | 328 | 400 |
| 250 | 63 | 81 | 99 | 117 | 135 | 153 | 171 | 189 | 207 | 225 | 243 | 261 | 333 | 405 |
| 275 | 68 | 86 | 104 | 122 | 140 | 158 | 176 | 194 | 212 | 230 | 248 | 266 | 338 | 410 |
| 300 | 72 | 90 | 108 | 126 | 144 | 162 | 180 | 198 | 216 | 234 | 252 | 270 | 342 | 414 |
| 350 | 81 | 99 | 117 | 135 | 153 | 171 | 189 | 207 | 225 | 243 | 261 | 279 | 351 | 423 |
| 400 | 90 | 108 | 126 | 144 | 162 | 180 | 198 | 216 | 234 | 252 | 270 | 288 | 360 | 432 |
| 450 | 99 | 117 | 135 | 153 | 171 | 189 | 207 | 225 | 243 | 261 | 279 | 297 | 369 | 441 |
| 500 | 108 | 126 | 144 | 162 | 180 | 198 | 216 | 234 | 252 | 270 | 288 | 306 | 378 | 450 |

NATIONAL CLAY PIPE INSTITUTE AIR TEST TABLES

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG

LENGTH OF 8" DIAMETER MAIN LINE IN FEET

| LENGTH OF 6" LATERAL | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 28 | 46 | 64 | 82 | 100 | 118 | 136 | 154 | 172 | 190 | 208 | 226 | 298 | 370 |
| 50 | 39 | 57 | 75 | 93 | 111 | 129 | 147 | 165 | 183 | 201 | 219 | 237 | 309 | 381 |
| 75 | 50 | 68 | 86 | 104 | 122 | 140 | 158 | 176 | 194 | 212 | 230 | 248 | 320 | 392 |
| 100 | 60 | 78 | 96 | 114 | 132 | 150 | 168 | 186 | 204 | 222 | 240 | 258 | 330 | 402 |
| 125 | 70 | 88 | 106 | 124 | 142 | 160 | 178 | 196 | 214 | 232 | 250 | 268 | 340 | 412 |
| 150 | 81 | 99 | 117 | 135 | 153 | 171 | 189 | 207 | 225 | 243 | 261 | 279 | 351 | 423 |
| 175 | 92 | 110 | 128 | 146 | 164 | 182 | 200 | 218 | 236 | 254 | 272 | 290 | 360 | 434 |
| 200 | 102 | 120 | 138 | 156 | 174 | 192 | 210 | 228 | 246 | 264 | 282 | 300 | 372 | 444 |
| 225 | 112 | 130 | 148 | 166 | 184 | 202 | 220 | 238 | 256 | 274 | 292 | 310 | 382 | 454 |
| 250 | 123 | 141 | 159 | 177 | 195 | 213 | 231 | 249 | 267 | 285 | 303 | 321 | 393 | 465 |
| 275 | 134 | 152 | 170 | 188 | 206 | 224 | 242 | 260 | 278 | 296 | 314 | 332 | 404 | 476 |
| 300 | 144 | 162 | 180 | 198 | 216 | 234 | 252 | 270 | 288 | 306 | 324 | 342 | 414 | 486 |
| 350 | 165 | 183 | 201 | 219 | 237 | 255 | 273 | 291 | 309 | 327 | 345 | 363 | 435 | 507 |
| 400 | 186 | 204 | 222 | 240 | 258 | 276 | 294 | 312 | 330 | 348 | 366 | 384 | 456 | 528 |
| 450 | 207 | 225 | 243 | 261 | 279 | 297 | 315 | 333 | 351 | 369 | 387 | 405 | 477 | 549 |
| 500 | 228 | 246 | 264 | 282 | 300 | 318 | 336 | 354 | 372 | 390 | 408 | 426 | 498 | 570 |

NATIONAL CLAY PIPE INSTITUTE AIR TEST TABLES

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG

LENGTH OF 10" DIAMETER MAIN LINE IN FEET

| LENGTH OF 4" LATERAL | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 27 | 50 | 72 | 94 | 117 | 140 | 162 | 184 | 207 | 230 | 252 | 274 | 364 | 454 |
| 50 | 32 | 54 | 76 | 99 | 122 | 144 | 166 | 189 | 212 | 234 | 256 | 279 | 369 | 459 |
| 75 | 36 | 58 | 81 | 104 | 126 | 148 | 171 | 194 | 216 | 238 | 261 | 284 | 374 | 464 |
| 100 | 40 | 63 | 86 | 108 | 130 | 153 | 176 | 198 | 220 | 243 | 266 | 288 | 378 | 468 |
| 125 | 45 | 68 | 90 | 112 | 135 | 158 | 180 | 202 | 225 | 248 | 270 | 292 | 382 | 472 |
| 150 | 50 | 72 | 94 | 117 | 140 | 162 | 184 | 207 | 230 | 252 | 274 | 297 | 387 | 477 |
| 175 | 54 | 76 | 99 | 122 | 144 | 166 | 189 | 212 | 234 | 256 | 279 | 302 | 392 | 482 |
| 200 | 58 | 81 | 104 | 126 | 148 | 171 | 194 | 216 | 238 | 261 | 284 | 306 | 396 | 486 |
| 225 | 63 | 86 | 108 | 130 | 153 | 176 | 198 | 220 | 243 | 266 | 288 | 310 | 400 | 490 |
| 250 | 78 | 90 | 112 | 135 | 158 | 180 | 202 | 225 | 248 | 270 | 292 | 315 | 405 | 495 |
| 275 | 72 | 94 | 117 | 140 | 162 | 184 | 207 | 230 | 252 | 274 | 297 | 320 | 410 | 500 |
| 300 | 76 | 99 | 117 | 122 | 144 | 166 | 189 | 212 | 234 | 256 | 279 | 302 | 324 | 4 |
| 350 | 86 | 108 | 130 | 153 | 176 | 198 | 220 | 243 | 266 | 288 | 310 | 333 | 423 | 513 |
| 400 | 94 | 117 | 140 | 162 | 184 | 207 | 230 | 252 | 274 | 297 | 320 | 342 | 432 | 522 |
| 450 | 104 | 126 | 148 | 174 | 194 | 216 | 238 | 261 | 284 | 306 | 328 | 351 | 441 | 531 |
| 500 | 112 | 135 | 158 | 180 | 202 | 225 | 248 | 270 | 292 | 315 | 338 | 360 | 450 | 540 |

NATIONAL CLAY PIPE INSTITUTE AIR TEST TABLES

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG

LENGTH OF 10" DIAMETER MAIN LINE IN FEET

| LENGTH OF 6" LATERAL | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 33 | 56 | 78 | 100 | 123 | 146 | 168 | 190 | 213 | 236 | 258 | 280 | 370 | 460 |
| 50 | 44 | 66 | 88 | 111 | 134 | 156 | 178 | 201 | 224 | 246 | 268 | 291 | 381 | 471 |
| 75 | 55 | 76 | 99 | 122 | 144 | 166 | 189 | 212 | 234 | 256 | 279 | 302 | 392 | 482 |
| 100 | 64 | 87 | 110 | 132 | 154 | 177 | 200 | 222 | 244 | 267 | 290 | 312 | 402 | 492 |
| 125 | 75 | 98 | 120 | 142 | 165 | 188 | 210 | 232 | 255 | 278 | 300 | 322 | 412 | 502 |
| 150 | 86 | 108 | 130 | 153 | 176 | 198 | 220 | 243 | 266 | 288 | 310 | 333 | 453 | 513 |
| 175 | 96 | 118 | 141 | 164 | 186 | 208 | 231 | 254 | 276 | 298 | 321 | 344 | 434 | 524 |
| 200 | 106 | 129 | 152 | 174 | 196 | 219 | 242 | 264 | 286 | 309 | 332 | 354 | 444 | 534 |
| 225 | 117 | 140 | 162 | 184 | 207 | 230 | 252 | 274 | 297 | 320 | 342 | 364 | 454 | 544 |
| 250 | 128 | 150 | 172 | 195 | 218 | 240 | 262 | 285 | 308 | 330 | 352 | 375 | 465 | 555 |
| 275 | 138 | 160 | 183 | 206 | 228 | 250 | 273 | 296 | 318 | 340 | 363 | 386 | 476 | 562 |
| 300 | 148 | 171 | 194 | 216 | 238 | 261 | 284 | 306 | 328 | 351 | 374 | 396 | 486 | 576 |
| 350 | 170 | 192 | 214 | 237 | 260 | 282 | 304 | 327 | 350 | 372 | 394 | 417 | 507 | 597 |
| 400 | 190 | 213 | 236 | 258 | 280 | 303 | 326 | 348 | 370 | 393 | 416 | 438 | 528 | 618 |
| 450 | 212 | 234 | 256 | 279 | 302 | 324 | 346 | 369 | 392 | 414 | 436 | 459 | 549 | 639 |
| 500 | 232 | 255 | 278 | 300 | 322 | 345 | 368 | 390 | 412 | 435 | 458 | 480 | 570 | 660 |

NATIONAL CLAY PIPE INSTITUTE AIR TEST TABLES

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG

LENGTH OF 12" DIAMETER MAIN LINE IN FEET

| LENGTH OF 4" LATERAL | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 32 | 58 | 86 | 112 | 122 | 166 | 194 | 220 | 248 | 274 | 302 | 328 | 436 | 544 |
| 50 | 36 | 63 | 90 | 117 | 144 | 171 | 198 | 225 | 252 | 279 | 306 | 333 | 441 | 549 |
| 75 | 40 | 68 | 94 | 122 | 148 | 176 | 202 | 230 | 256 | 284 | 310 | 338 | 446 | 554 |
| 100 | 45 | 72 | 99 | 126 | 153 | 180 | 207 | 234 | 261 | 288 | 315 | 342 | 450 | 558 |
| 125 | 50 | 76 | 104 | 130 | 158 | 184 | 212 | 238 | 266 | 292 | 320 | 346 | 454 | 562 |
| 150 | 54 | 81 | 108 | 135 | 162 | 189 | 216 | 243 | 270 | 297 | 324 | 351 | 459 | 567 |
| 175 | 58 | 86 | 112 | 140 | 166 | 194 | 220 | 248 | 274 | 302 | 328 | 356 | 464 | 572 |
| 200 | 63 | 90 | 117 | 144 | 171 | 198 | 225 | 252 | 279 | 306 | 333 | 360 | 468 | 576 |
| 225 | 68 | 94 | 122 | 148 | 176 | 202 | 185 | 256 | 284 | 310 | 338 | 364 | 472 | 580 |
| 250 | 72 | 99 | 126 | 153 | 180 | 207 | 234 | 261 | 288 | 315 | 342 | 369 | 477 | 585 |
| 275 | 76 | 104 | 130 | 158 | 184 | 212 | 238 | 266 | 292 | 320 | 346 | 374 | 482 | 590 |
| 300 | 81 | 108 | 135 | 162 | 189 | 216 | 243 | 270 | 297 | 324 | 351 | 378 | 486 | 594 |
| 350 | 90 | 117 | 144 | 171 | 198 | 225 | 252 | 279 | 306 | 333 | 360 | 387 | 495 | 603 |
| 400 | 99 | 126 | 153 | 180 | 207 | 234 | 261 | 288 | 315 | 342 | 369 | 396 | 504 | 612 |
| 450 | 108 | 135 | 162 | 189 | 216 | 243 | 270 | 297 | 324 | 351 | 378 | 405 | 513 | 621 |
| 500 | 117 | 144 | 171 | 198 | 225 | 252 | 279 | 306 | 333 | 360 | 387 | 414 | 522 | 630 |

NATIONAL CLAY PIPE INSTITUTE AIR TEST TABLES

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG

LENGTH OF 12" DIAMETER MAIN LINE IN FEET

| LENGTH OF 6" LATERAL | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 400 | 500 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 38 | 64 | 92 | 118 | 146 | 172 | 200 | 226 | 255 | 280 | 308 | 334 | 442 | 550 |
| 50 | 48 | 75 | 102 | 129 | 156 | 183 | 210 | 237 | 264 | 291 | 318 | 345 | 453 | 561 |
| 75 | 58 | 86 | 112 | 140 | 166 | 194 | 220 | 248 | 274 | 302 | 328 | 356 | 464 | 572 |
| 100 | 69 | 96 | 123 | 150 | 237 | 204 | 231 | 258 | 285 | 312 | 339 | 366 | 474 | 582 |
| 125 | 80 | 106 | 134 | 160 | 188 | 214 | 242 | 268 | 296 | 322 | 350 | 376 | 484 | 592 |
| 150 | 90 | 117 | 144 | 171 | 198 | 225 | 252 | 279 | 306 | 333 | 360 | 387 | 495 | 603 |
| 175 | 100 | 128 | 154 | 182 | 208 | 236 | 262 | 290 | 316 | 344 | 370 | 398 | 506 | 614 |
| 200 | 111 | 138 | 165 | 192 | 219 | 246 | 273 | 300 | 327 | 354 | 381 | 408 | 516 | 624 |
| 225 | 122 | 148 | 176 | 202 | 230 | 256 | 284 | 310 | 338 | 364 | 392 | 418 | 526 | 634 |
| 250 | 132 | 159 | 186 | 213 | 240 | 267 | 294 | 321 | 348 | 375 | 402 | 429 | 537 | 645 |
| 275 | 142 | 170 | 196 | 224 | 250 | 278 | 304 | 332 | 358 | 386 | 412 | 440 | 548 | 656 |
| 300 | 153 | 180 | 207 | 234 | 261 | 288 | 315 | 342 | 369 | 396 | 423 | 450 | 558 | 666 |
| 350 | 174 | 201 | 228 | 255 | 282 | 309 | 336 | 363 | 390 | 417 | 444 | 471 | 579 | 687 |
| 400 | 195 | 222 | 249 | 276 | 303 | 330 | 357 | 384 | 411 | 438 | 465 | 492 | 600 | 708 |
| 450 | 216 | 243 | 270 | 297 | 324 | 351 | 378 | 405 | 432 | 459 | 486 | 513 | 621 | 729 |
| 500 | 237 | 264 | 291 | 318 | 345 | 372 | 397 | 426 | 453 | 480 | 507 | 534 | 642 | 750 |

## B. Air Test for PVC Gravity Sewers

1. Test Section: Each section of sewer between two successive manholes shall be tested by plugging all pipe outlets with suitable test plugs. All test plugs shall be secured in place to prevent movement or slippage.

2. Addition of Air: 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 blowoff valve set at 5 psig to ensure that at no time the internal pressure in the pipe exceeds 5 psig.

3. Internal Pressure: 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.

4. Minimum Duration for Allowable Pressure Drop: 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 air test pressure drop shown in Table I.

TABLE I

MININUM DURATION FOR AIR
TEST PRESSURE DROP

| Pipe Size (Inches) | Time (Minutes) |
|---|---|
| 4 | 2½ |
| 6 | 4 |
| 8 | 5 |
| 10 | 6½ |
| 12 | 7½ |
| 15 | 9½ |

5. Retest: If the pressure drop from 3.5 psig to 3.0 psig occurs in less time than the above-tabulated or calculated values, the pipe shall be overhauled and, if necessary, replaced and relaid until the joints and pipe shall hold satisfactorily under this test.

## C. Infiltration Test

1. Preparation of Test Section: The end of the sewer at the upper structure shall be closed to prevent the entrance of water, and pumping of groundwater shall be discontinued for at least three days, after which the section shall be tested for infiltration.

2. Allowable Infiltration Rate: The infiltration shall not exceed 0.025 gpm per inch of diameter per 1,000 feet of main line sewer being tested, not including the length of laterals entering that section.

3. Excessive Infiltration: Where infiltration in excess of the allowable amount is discovered before completion and acceptance of the sewer, the sewer shall be immediately uncovered and the amount of the infiltration reduced to a quality within the specified amount of infiltration, before the sewer is accepted.

4. Individual Leaks: Even if the infiltration is less than the allowable amount, any individual leaks that may be observed shall be stopped as ordered by the District Representative.

5. Completion of Tests: All tests must be completed before the street or trench is resurfaced, unless otherwise directed by the District Representative.

## D. Deflection Test

General: All flexible and semi-rigid main line pipe shall be tested for deflection, joint displacement, or other obstruction by passing a rigid mandrel through the pipe by hand, not less than 30 days after completion of the trench backfill, but prior to permanent resurfacing. The mandrel shall be a full circle, solid cylinder, or a cylinder, approved by the DISTRICT as to design and manufacture. The circular cross section of the mandrel shall have a diameter of at least 95 percent of the specified average inside pipe diameter of the pipe.

## E. Manhole Test

1. General: Water tightness of manholes shall be tested in conjunction with tests of sanitary sewers, or at the time the manhole is completed and backfilled.

2. Plugs: All manhole inlets and outlets shall be plugged with approved stoppers or plugs.

3. Fill Level: The manhole shall be filled with water to 2-inches below the bottom of the tapered cone section, with a minimum depth of 4 feet and a maximum depth of 20 feet. The water shall stand in the manhole for a minimum of one hour to allow the manhole material to reach maximum

absorption. Before the test is to begin, the manhole shall be refilled to the original depth as needed.

4. Test Requirements: The drop in water surface shall be recorded after a period of 15 minutes to one hour. The time of the test shall be determined by the District Representative and may be varied to fit the various field conditions. The maximum allowable drop in the water surface shall be 1/2 inch for each 15-minute period of testing.

5. Visible Leaks: Even though the leakage is less than the specified amount, the Contractor shall stop any leaks that may be observed, to the satisfaction of the District Representative.

**END OF SECTION**

# SECTION 15051

# INSTALLATION OF PRESSURE PIPELINES

## PART 1 - GENERAL

### A. Description

This section describes the installation of pressure pipelines fabricated of polyvinyl chloride, ductile iron, CML&C welded steel, prestressed concrete, and pretensioned concrete, pipeline closures and connections and pipeline encasement.

### B. Related Work Described Elsewhere

1. Trenching, Backfilling, and Compacting: 02223
2. Concrete: 03300
3. Painting and Coating: 09900
4. Chlorination of Water Mains for Disinfection: 15041
5. Hydrostatic Testing of Pressure Pipelines: 15042
6. Air-Release and Vacuum-Release Valves: 15089
7. Water & Sewer Facilities Identification: 15151
8. Cathodic Protection and Joint Bonding: 16640

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300 and the following.
2. An installation schedule (tabulated layout) shall be submitted which includes:
    a. Order of installation and closures.
    b. Pipe centerline station and elevation at each change of grade and alignment.
    c. Elements, curves, and bends, both in horizontal and vertical alignment including elements of the resultant true angular deflections in cases of combined curvature.

d. The location, length, size, design designation, and number designation of each pipe section and pipe special.

e. Locations of junction structures.

3. Welder qualification certificates shall be submitted.

## PART 2 - MATERIALS

### A. Installation Material

Refer to the various referenced sections on pipe by type for material requirements.

### B. Piping Schedule

Unless noted otherwise on the plans or in the specifications, pipe shall be furnished in accord with the following materials schedule.

| Diameter | Pipe Material |
|---|---|
| 2-inch and smaller | Copper |
| 4-inch through 12-inch | PVC C900 |
| Larger than 12-inch | CML&C Steel |
| Notes: Copper pipe per Section 15057<br>Ductile iron pipe (DIP) per Section 15056<br>PVC C900 per Section 15064<br>Cement mortar lined and coated (CML&C) steel pipe per Section 15076 | |

## PART 3 - EXECUTION

### A. Delivery and Temporary Storage of Pipe at Site

1. Onsite Storage Limitation: Onsite pipe storage shall be limited to a maximum of one week, unless exception is approved by District.

2. Care of Pipe: Care shall be taken to avoid cracking of the cement mortar coating and/or lining on steel pipe. Plastic sheet caps shall be used to close pipe ends and keep coatings and linings moist. In addition, all pipe stored onsite shall be protected from the sun via canvas or other opaque material to prevent UV degradation. Placement of this material shall allow for adequate air circulation between the cover and the pipe.

## B. Handling of Pipe

1. Moving Pipe: Pipes shall be lifted with handling beams or wide belt slings as recommended by the pipe manufacturer. Cable slings shall not be used. Pipe shall be handled in a manner to avoid damage to the pipe. Pipe shall not be dropped or dumped from trucks or into trenches under any circumstances.

2. Internal Pipe Braces: Internal braces placed in steel pipes shall be maintained until backfilling is completed.

3. Pipe Caps: Plastic caps placed over the ends of steel pipe shall not be removed until the pipe is ready to be placed in the trench. Plastic caps may be opened temporarily to spray water inside the pipe for moisture control.

4. Inspection of Pipe: The pipe and accessories shall be inspected for defects prior to lowering into the trench. Any defective, damaged or unsound pipe shall be repaired or replaced. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench.

## C. Placement of Pipe in Trench

1. General: Dewatering, excavation, shoring, sheeting, bracing, backfilling material placement, material compaction, compaction testing, and pipe laying requirements and limitations shall be in accordance with Section 02223: Trenching, Backfilling and Compacting.

2. Sanitation of Pipe Interior: During laying operations, tools, clothing, or other materials shall not be placed in the pipe.

3. Prevention of Entry into Pipe: When pipe laying is not in progress, including lunch-hour, the ends of the pipe shall be closed using vermin-proof plugs constructed in a manner to also prevent entry by children.

4. Laying Pipe on Grades over 10 Percent: Pipes shall be laid uphill whenever the grade exceeds 10 percent.

5. Pipe Base Thickness: Pipe base thickness shall be as specified in Section 02223, Trenching, Backfilling, and Compacting.

6. Depressions at Joints and Pipe Sling Points: Depressions shall be dug into pipe base material to accommodate the pipe bell and external joint filler form, and to permit removal of the pipe handling slings.

7. Placement of Pipe on Pipe Base: Pipe shall be lowered onto the bedding and installed to line and grade its full length on firm bearing except at the bell and at sling depressions. Unless specified otherwise, the tolerance on grade shall

be ¼-inch; the tolerance on line shall be 1-inch. Grade shall be measured along the pipe invert. Pipe shall be installed with the pipe identification marking facing up.

8. Pipe Installation: Pipe shall be installed without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment. Precautions shall be taken to prevent pipe from being displaced by water entering trench. Damaged or displaced pipe shall be replaced or returned to specified condition and grade.

9. Trench Curvature and Pipe Deflection: The radius of curvature of the trench shall be determined by the maximum length of pipe section that can be used without exceeding the allowable deflection at a coupling. Refer to the various referenced sections on pipe by type for allowable deflection. The deflection at any flexible joint shall not exceed that prescribed by the manufacturer of the pipe. The manufacturer's printed installation guide outlining the radius of curvature that can be negotiated with pipe sections of various lengths shall be followed.

10. Equipment for Installation of Pipe: Proper implements, tools, and facilities as recommended by the pipe manufacturer's standard printed installation instructions shall be provided and used by the Contractor for safe and efficient execution of the work. All pipe, fittings, valves, and accessories shall be carefully lowered into the trench using suitable equipment in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.

11. Cutting and Machining Pipe: Cutting and machining of the pipe shall be accomplished in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, nor any other method that may fracture the pipe or produce ragged, uneven edges.

## D. Assembling Rubber-Gasketed Joints

1. Cleaning Ends of Pipe: The ends of the pipe to be joined shall be cleaned of foreign material.

2. Lubrication: After placing pipe in trench, a nontoxic water soluble vegetable soap solution shall be applied to the inside of the pipe bell and to the rubber gasket and spigot of the pipe to be installed. The rubber gasket shall be stretched into the groove in the bell-end of the pipe and distributed uniformly around the circumference.

3. Joint Assembly: Without tilting the pipe to be installed, the spigot shall be inserted into the bell of the pipe. Come-a-longs or pipe jacks shall be used to

drive spigot end home horizontally. The joint recess recommended by pipe manufacturer for made-up joints shall be maintained. Where deflections at joints are required for curved alignment, the allowable joint opening on one side shall not be exceeded. A feeler gauge shall be used to verify proper placement of each gasket.

## E. Flanged Connections

1. Bolt hole Alignment: Pipe shall be set with flange bolt holes straddling the pipe horizontal and vertical centerlines.

2. Nuts and Bolts: Nuts and bolts shall be lubricated with anti-seize prior to installation.

3. Flange Wrapping: Flanges which connect with buried valves or other equipment shall be wrapped with sheet polyethylene film or wax tape material as specified for the valves and equipment. The wrap shall be extended over the flanges and bolts and secured around the adjacent pipe circumference with tape.

4. Coating: All buried flanges and bolts shall be completely coated with two coats of 10 mil each of Sanchem, Inc. NO-OX-ID "A SPECIAL" soft grease type rust preventative or coal-tar epoxy (bitumastic) or approved equal.

## F. Installation of Bends, Tees, and Reducers

Fittings shall be installed utilizing standard installation procedures. Fittings shall be lowered into trench by means of rope, cable, chain, or other acceptable means without damage to the fittings. Cable, rope, or other devices used for lowering fitting into trench, shall be attached around exterior of fitting for handling. Under no circumstances shall the cable, rope or other device be attached through the fittings interior for handling. Fittings shall be carefully connected to pipe or other facility, and joint shall be checked to insure a sound and proper joint.

## G. Installing Threaded Piping

Threaded piping shall be reamed, deburred, and cleaned before making up joints. Thread lubricant approved by the District representative shall be applied to threaded pipe ends before installing fittings, couplings, unions, or joints.

## H. Completion of Interior Joints for Mortar-Lined Pipes 20-Inches in Diameter and Smaller

1. Preparation: A tight-fitting swab or squeegee shall be inserted in the joint end of the pipe to be joined.

2. Application of Cement Mortar: When ready to insert the spigot, the face of the cement mortar lining at the bell shall be coated with a sufficient amount of stiff cement mortar to fill the space between adjacent mortar linings of the two pipes to be joined.

3. Removal of Excess Mortar: Immediately after joining the pipes, the swab or squeegee shall be drawn through the pipe to remove all excess mortar and expel it from the open pipe end.

4. Alternative to Cement Mortar: GS-79 Extruded Butyl Rubber Pipe Joint Sealant, by General Sealants, Inc. may be used instead of cement mortar.

## I. Completion of Interior Joints for Mortar-Lined Pipes Greater Than 20-Inches in Diameter

1. Backfill Requirement: The trench shall be backfilled, compacted, and meet compaction requirements before applying mortar at joints.

2. Cleaning and Application of Cement Mortar: Working inside the pipe, foreign substances which adhere to the steel joint rings shall be removed, the surface cleaned, and stiff cement mortar packed into each joint. The mortar shall be finished with a steel trowel to match the lining in the adjoining pipes.

3. Removal of Excess Mortar: Excess mortar and other construction debris shall be removed from the pipe interior.

## J. Pipeline Closure Assemblies

1. General: Pipeline closure assemblies shall be employed to unite sections of pipeline laid from opposite directions; to adjust the field length of the pipeline to meet structures, other pipelines, and points established by design stations; and to close areas left open to accommodate temporary test bulkheads for hydrostatic testing. Either follower ring design or butt strap design shall be used. Follower ring closures shall be installed as recommended by the pipe manufacturer.

2. Butt Straps: As shown in the Standard Drawing W-25, Shaped steel butt straps with the minimum width of 9-inches shall be centered over the ends of the pipe sections they are to join. On pipes 39-inches in diameter and smaller, butt straps shall be welded to the outside of the pipes with complete circumferential

fillet welds equal in size to the thinnest part being joined. The details shown on the drawings shall be referred to when joining larger pipes.

3. General Requirements for Cement Mortar Lining for Closure Assemblies: Closure assemblies shall be cement-mortar lined to a mortar thickness at least equal to the adjoining standard pipe sections. The steel shall be cleaned with wire brushes and a cement and water wash coat applied prior to applying the cement mortar. Where more than a 4-inch joint strip of mortar is required, welded wire mesh reinforcement having a 2-inch by 4-inch pattern of No. 13 gage shall be placed over the exposed steel. The mesh shall be installed so that the wires on the 2-inch spacing run circumferentially around the pipe. The wires on the 4-inch spacing shall be crimped to support the mesh 3/8-inch from the metal surface. The interior mortar shall have a steel-trowled finish to match adjoining mortar lined pipe sections.

4. Lining Closure Assemblies for Pipes 20-Inches in Diameter and Smaller: For lining of closure assemblies on pipelines 20-inches in diameter and smaller, threaded 4-inch nipples with galvanized plugs shall be provided around the perimeter of the closure at third-point intervals to facilitate mortar lining of the interior surface.

5. Mortar Coating Exterior Surfaces of Closure Assemblies: The exterior of closure assemblies shall be reinforced with wire mesh as described in Paragraph 3 above. The surface shall be coated with mortar, or a poured concrete encasement to cover all steel to a minimum thickness of 1½ inches. Exterior mortar shall be protected to retard drying while curing. Concrete shall be poured and vibrated on one side of the closure assembly only, until mortar is visible on the opposite side, after which the coating can be completed over the top of the assembly.

## K. Welded Joints

1. Locations: Welded joints shall be provided where detailed on the plans.

2. Reference Standard: Welding shall be in accordance with AWWA C206. Welder's qualification shall be in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. Current certifications shall be provided for all welders.

3. Sequence: Interior joints shall not be welded before completing the backfilling, compaction and compaction testing are successfully completed.

4. Joint Rings: Joint rings (butt straps or weld collars) that are rusted or pitted where weld metal is to be deposited shall be cleaned by brushing or sand blasting.

5. Restrictions: Concrete or other coating adjacent to the joint rings shall not be heated.

6. Cleaning Requirements: Each layer of deposited weld metal shall be cleaned using a power-driven wire brush prior to depositing the next layer of weld metal.

## L. Operations Incidental to Joint Completion

1. Hydrostatic Testing: Joint completion shall be planned to accommodate temporary test bulkheads for hydrostatic testing.

2. Bonding Pipe: Metallic jumper bonds or bars shall be installed on all metallic pipe, as shown on plans and as specified within Section 16640: Cathodic Protection and Joint Bonding.

## M. Completion of Exterior Pipe Joint for Cement-Mortar Coated Pipe

Outside joint recess shall be filled with cement-mortar grout using a fabric form (joint diaper) placed around the joint and secured with steel straps. Grout shall be poured and rodded from one side only until it is visible on the opposite side. After approximately one hour, the joint shall be topped off with additional grout.

## N. Thrust Restraint and Anchor Blocks

1. Location: Thrust restraint and anchor blocks shall be provided on all pressure pipelines, and shall be installed as shown on the plans and at all rubber gasketed fittings that are not otherwise restrained. Thrust restraint blocks or anchor blocks shall be installed at all valves, tees, crosses, ends of pipelines, and at all changes of direction of the pipeline greater than 10 degrees deflection either vertically or horizontally when joints are not otherwise restrained.

2. General Requirements: Thrust restraint and anchor blocks shall be of not less than 2,500 psi concrete (Class B); and shall provide a thrust bearing area to resist horizontal or downward thrust; and shall be of sufficient gross weight and area to give bearing against undisturbed vertical earth banks sufficient to absorb the thrust, allowing an earth bearing of 1,500 pounds per square foot maximum. Thrust blocks shall be in accordance with Standard Drawing W-12.

3. Thrust Restraint not Called for on the Plans: Thrust restraint elements, where not called for on the plans, shall be sized for 150 percent of operating pipeline pressure or the pipeline test pressure, whichever is greater. Prior to construction, thrust and anchor block sizing shall be submitted to the District for approval. Pipe clamps, tie-rods, and their assembly shall meet the

requirements of the National Fire Protection Association Bulletin No. 24, latest edition.

4. Concrete Placement: Concrete shall be placed against wetted and undisturbed soil, and the exterior of the fitting shall be cleaned and wetted to provide a good bond with the concrete. The concrete interface with the fitting shall be an area of not less than the projected area of the fitting normal to the thrust resultant and centered on the resultant.

5. Accessibility to Joints and Fittings: Unless otherwise directed by the District, thrust restraint and anchor blocks shall be placed so that the pipe and fitting joints are accessible for repair. Placement shall include isolation of adjacent utilities and shall ensure that bearing is against undisturbed soil.

6. Harness and Tie-Rods: Metal harness or tie-rods and pipe clamps shall be used to prevent movement if shown on the plans or directed by the District. The rods and clamp harnessing arrangement shall be installed utilizing flanged harness hold-downs or lugged fittings and pipe with saddle clamps placed to bear against the pipe bells. Saddle clamps around the barrel of the pipe, which depend on friction to prevent sliding of the clamp, are acceptable. However, restraints with pointed set-screws which bear into the pipe wall are not acceptable for PVC piping and shall not be used. All surfaces of exposed and buried steel rods, reinforcing steel, bolts, clamps, and other metal work shall be coated before installation and touched up after assembly as specified in Section 09900, Painting and Coating.

7. In-line Valves: Reinforcing steel tiedown bars and rods shall be used on all in-line valves. Exposed metal portions shall be coated with bitumastic material as specified in Section 09900, Painting and Coating, System D-1, "Buried Metal Coating Systems."

## O. Blow-off Assemblies

1. Location: The assembly shall be installed in a level section of pipe. The tap for blowoff in the line shall be no closer than 18 inches to a valve, coupling, joint, or fitting unless it is at the end of the main. See Standard Drawing W-27.

2. Restrictions: Blowoffs shall not be connected to any sewer, submerged in any stream, or installed in any manner that will permit back siphoning into the distribution system.

## P. Combination Air and Vacuum Release Valves

1. General: Air release valve assemblies and combination air and vacuum valves shall be installed at each point in the pipeline as shown on the drawings or as specified by the District, and in accordance with Section 15089: Air-Release and Vacuum-Relief Valves. See Standard Drawings W-10 and W-10A.

2. Location: 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. No tap shall be permitted in any machined section of asbestos cement pipe.

## Q. Aboveground Piping Installation/Support

1. General: Installation of aboveground pipeline materials and appurtenances include requirements for buried pipeline materials and appurtenances as applicable.

2. Supports: All exposed pipe shall be adequately supported with devices of appropriate design. Where details are shown, the supports shall conform thereto and shall be placed as indicated; provided, that the support for all piping shall be complete and adequate as herein specified, whether or not supporting devices are specifically called for. Pipe hangers and supports shall conform to the requirements of the latest editions of the MSS-SP58 and SP69 and ANSI/ASME B31.1.

3. Grooved-End Pipe and Fittings: Grooved-end pipe and fittings shall be installed in accordance with the coupling manufacturer's recommendations and the following:

    a. Loose scale, rust, oil, grease, and dirt shall be cleaned from the pipe or fitting groove. The coupling manufacturer's gasket lubricant shall be applied to the gasket exterior including lips, pipe ends, and housing interiors.

    b. Coupling shall be tightened alternately and evenly until coupling halves are seated.

## R. Cathodic Protection and Joint Bonding

All ferrous metal pipes and all pipes specified or shown on the plans to be cathodically protected shall be completed in accordance with Section 16640: Cathodic Protection and Joint Bonding.

## S. Detectable Warning Tape and Tracer Wire

Detectable warning tape shall be installed on all pipelines. In addition, tracer wire shall also be installed for non-metallic pipelines. The pipe identification and installation of the detectable warning tape and tracer wire shall be in accordance with Section 15151: Water & Sewer Facilities Identification.

## T. Disinfection

All potable water pipelines shall be disinfected in accordance with Section 15041, Chlorination of Water Mains for Disinfection.

## U. Testing

All pressure piping shall be hydrostatically pressure tested in accordance with Section 15042, Hydrostatic Testing of Pressure Pipelines.

**END OF SECTION**

# SECTION 15056

# DUCTILE-IRON PIPE AND FITTINGS

## PART 1 – GENERAL

### A. Description

This section describes materials, installation, and testing of ductile-iron pipe and fittings.

### B. Related Work Specified Elsewhere

1. Trenching, Backfilling, and Compacting: 02223
2. Chlorination of Water Mains for Disinfection: 15041
3. Hydrostatic Testing of Pressure Pipelines: 15042
4. Installation of Pressure Pipelines: 15051
5. Manual Valves: 15100
6. Cathodic Protection and Joint Bonding: 16640

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300 and the following.
2. Affidavits of compliance with standards referenced in this specification, e.g., AWWA C151, shall be provided.
3. Layout drawings showing the locations and dimensions of pipe and fittings shall be submitted. Include laying lengths of valves, meters and other equipment determining piping dimensions. For pipe sizes larger than 20-inches in diameter, label or number each fitting or piece of pipe.
4. Lining, coating and wall thickness for all piping shall be provided.
5. Joint details for all types of joints used, e.g., push-on joints shall be submitted.
6. Calculations and/or test data proving that each proposed restrained joint arrangement can transmit the required forces shall be submitted.

## D. Measurement and Payment

1. Payment for the work in this section shall be in accordance with the General Provisions and the following:

2. Payment shall be by the linear foot for each diameter and for each pipe strength designation measured horizontally over the pipe centerline, exclusive of the distance between the inside faces of junctions or other structures.

## E. Inspection

The District reserves the right to inspect materials, production, and testing of pipes, fittings, and special pieces at the manufacturer's plant.

# PART 2 - MATERIALS

## A. Ductile-Iron Pipe

1. AWWA Reference Standard: Ductile-iron pipe shall be manufactured in accordance with ANSI/AWWA C151/A21.51.

2. Minimum Wall Thickness: The minimum wall thickness for ductile-iron pipe shall be as specified in AWWA C150 for the design pressure class, and thickness Class 53 for flanged spools, unless indicated otherwise on the plans.

3. Joints: Unless otherwise called out on the plans, push-on type joints shall be used. The joint dimension and gasket shall be as specified in ANSI/AWWA C111/ A21.11. All pipe joints shall be bonded to provide electrical continuity for corrosion monitoring and future cathodic protection. For joint-bonding details and requirements, refer to the YLWD Standard Drawings and to Section 16640, Cathodic Protection and Joint Bonding.

4. Flanges: Flanges for ductile-iron pipe, when required, shall be "screwed-on" type in accordance with ANSI/AWWA C115/A21.15.

5. Restrained Joints: Restrained joint pipe shall be used only where shown on the plans. The pipe manufacturers' standard restrained joints shall be of the type utilizing cast lugs, shop welded retainer lugs, retainer rings bearing against pipe shoulders, or retainer rings in pipe grooves. Where the restrained joint is of the grooved type, the wall thickness beneath the groove shall be equal to or greater than the minimum specified wall thickness. Retainer glands or uniflange adapters utilizing setscrews bearing against the pipe wall are not acceptable for buried pipe harnessing. Field welding of the restrained joint or components is not acceptable. Field-lock gaskets are acceptable on pipes 10-inches in diameter and smaller. Restrained joint pipe and fitting shall be as

manufactured by American Pipe, Clow F-128 Super-lock pipe, U.S. Pipe, or for contracts between District and Contractor, approved equal.

6. Manufacturers: Ductile-iron pipe shall be as manufactured by American Pipe, Pacific States, U.S. Pipe, or for contracts between District and Contractor, approved equal.

**B. Ductile-Iron Fittings**

1. AWWA Reference Standard: Ductile-iron fittings shall be manufactured in accordance with ANSI/AWWA C110/A21.10. Ductile iron compact body fittings may be used for fitting sizes 4-inches through 24-inches in diameter and shall be manufactured in accordance with ANSI/AWWA C153/A21.53. Ductile-iron fittings shall be either flanged or mechanical joint.

2. Restrained Joints: Restrained joint fittings shall be used only as shown on the plans. Joint restraint shall be as specified in this Section for ductile iron pipe.

3. Hydrostatic Pressure Test: Each fitting shall be tested before lining to one and one-half times the operating pressure for a duration of 10 seconds. Suitable controls and recording devices shall be provided so that the test pressure and duration may be adequately ascertained. Any fitting that does not withstand the test pressure shall be rejected. The Contractor may be required to notify the District in advance of the date, time, and place of inspection and testing of the fittings in order that the District may be represented at the tests. When specified in the special provisions, in some cases, the District may require a certification of compliance to these specifications.

4. Bell Ends: Bell ends shall be compatible with the pipe ends so as to provide confinement of the rubber rings and prevent damage to the ends of the pipe. Ring grooves and interior surfaces of the bell shall be smooth and free from ridges, notches, or uneven surfaces.

5. Mechanical Joints: Mechanical joint fittings shall be used for all ductile-iron fitting joints, unless otherwise noted on the plans. Ductile iron mechanical joint fittings shall comply with ANSI/AWWA C-111/A-21.11, with a pressure rating of 250 psi and an ANSI Class 125 and Class 150 bolt pattern. Tee bolts for mechanical joint fittings shall be Type 316 stainless steel.

6. Mechanical Joint Restraint Systems: Mechanical joint fittings with retainer gland fittings will only be allowed in areas specifically called for on the plans or as approved by the District as a substitute for other types of fittings. Mechanical joint fittings shall meet or exceed the ASTM A-536 requirements. Torque off bolts shall be tightened per manufacturer's recommendations and shall be inspected by the District prior to backfill. Manufacturers: EBAA

Iron, Romac RomaGrip, Ford Meter Box, Sigma Corporation or for contracts between District and Contractor, approved equal.

7. Flanged Fittings: Unless otherwise indicated on the drawings, all fittings with flanged ends shall comply with ANSI/AWWA C110/A21.10, with a pressure rating of 150 psi. The gasket surface shall have a serrated finish of approximately 16 serrations per inch, approximately 1/32-inch deep, with serrations in either a concentric or spiral pattern. In addition, all flanges shall meet the following tolerances:

| Description | Tolerance |
|---|---|
| Bolt circle drilling | ±1/16 inch |
| Bolt hole spacing | ±1/32 inch |
| Eccentricity of bolt circle and facing with respect to bore center | ±1/32 inch |

8. Manufacturers: Fittings shall be manufactured by American Pipe, McWane Ductile, Sigma Corporation, SIP Industries, Star Pipe Products, U.S. Pipe, Tyler Union, or for contracts between District and Contractor, approved equal.

## C. Gaskets

1. Gaskets for Flanged Joints: Gaskets for flanged joints shall be 1/8-inch thick, cloth-inserted rubber or compressed non-asbestos fiber. Gaskets shall be suitable for a water pressure of 350 psi at a temperature of 160°F. Gaskets shall be NSF 61 certified for potable water applications, and compatible with water that may have a chlorine residual of 25 mg/L.

2. Full Face Type Gaskets for Flanged Joints: Full face type gaskets with pre-punched holes shall be used where both flanges are flat face. Ring gaskets extending to the inner edge of the bolts may be used where a raised face flange is present. Gaskets shall be 1/8-inch thick, cloth-inserted rubber or compressed non-asbestos fiber. Gaskets shall be suitable for a water pressure of 350 psi at a temperature of 160°F. Gaskets shall be NSF 61 certified for potable water applications, and compatible with water that may have a chlorine residual of 25 mg/L.

3. Gaskets for Push-on, Mechanical, and Restrained Joints: Gaskets for push-on, mechanical, and restrained joints shall be synthetic or natural rubber in accordance with AWWA C111. Gaskets shall be NSF 61 certified for potable water applications, and compatible with water that may have a chlorine residual of 25 mg/L.

4. Manufacturers: Gasket shall be Teadit, Buffalo Rubber Matting, Tripac or for contracts between District and Contractor, approved equal.

## D. Bolts, Nuts, and Washers

1. General: Bolts and nuts for buried and submerged flanges shall be Type 316 stainless steel conforming to ASTM A 193, Grade B8M for bolts, and ASTM A 194, Grade 8M for nuts. Bolts and nuts for flanges located above ground and in vaults and structures shall be Grade B7 zinc-plated carbon steel.

2. Washers: A Type 316 stainless steel washer shall be provided for each nut.

3. Bolt Projection: The length of each bolt or stud shall be such that between 1/4 inch and 3/8 inch will project through the nut when drawn tight.

## E. Lining for Pipe and Fittings

1. Water Application: The interior of all pipe and fittings shall be lined with cement-mortar per ANSI/AWWA C104/A21.4. Lining shall be the double thickness listed in AWWA C104, Section 4.8. Lining materials shall conform to ASTM C150, Type II.

2. Sewer Application: The interior of all pipe and fittings shall be lined with ceramic epoxy, consisting of an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment.

## F. Coating for Pipe and Fittings

1. Exterior Surfaces: Exterior surfaces of pipe and fittings shall be coated with an asphaltic material in conformance with ANSI/AWWA C104/A21.4, and ANSI/AWWA C153/A21.53. The coating shall be free from blisters and holes; shall adhere to the metal surface at ambient temperatures encountered in the field.

2. Coating for Bolts, Nuts, and Glands: Buried mechanical joint bolts, nuts and glands, and restrained joint bolts for field-cut closure pipe shall be coated per Section 09900, Painting and Coating. Stainless steel parts shall not be coated except for the threaded portion, which shall be assembled with a liberal coat of anti-seize compound.

## G. Polyethylene Encasement

Pipe and fittings shall be polyethylene encased in accordance with ANSI/AWWA C105/A21.5.

## PART 3 - EXECUTION

### A. General

Ductile-iron pipe and ductile iron fittings shall be installed in accordance with the applicable sections of AWWA C600 and as specified in Section 15051, Installation of Pressure Pipelines.

### B. Installation

1. Allowable Joint Deflection for Restrained Joint Pipe and Fittings: For restrained joints, deflection of the joint shall not exceed the manufacturer's recommended maximum deflection.

2. Acceptable Line and Grade for Piping: The pipe shall be laid true to the line and grade shown on the plans within acceptable tolerances. The tolerance on grade is 1-inch. The tolerance on line is 2-inches.

3. Touch-Up Coating: All exposed flanges and other metal surfaces and all damaged coatings shall be coated after assembly per Section 09900, Painting and Coating. Stainless steel bolts shall not be coated.

### C. Wrapping pipe with Polyethylene Encasement

All ductile-iron pipe and ductile/gray-iron fittings buried underground shall be protected with a polyethylene encasement wrap in accordance with the latest revision of AWWA C105. Wrap shall be a loose 8-mil-thick minimum low-density polyethylene tube or a 4-mil-thick high-density cross-laminated polyethylene tube. Double wrap shall be installed when called for in the plans. All joints between plastic tubes shall be wrapped with 2-inch-wide, 10-mil thick, polyethylene adhesive tape, Polyken 900, Scotchwrap 50, or for contracts between District and Contractor, approved equal. Installation of plastic film shall conform to the following procedure, and wrapping shall be applied to the pipe in the field in the following manner:

1. Placement of Polyethylene Encasement: Using a sling, the pipe shall be picked up with a crane at the side of the trench and raised about 3 feet off the ground. The polyethylene tube, cut approximately 2 feet longer than the length of pipe, shall be slipped over the spigot end of the pipe and bunched up, accordion fashion, between end of the pipe and the sling.

2. Placement of Pipe into Trench: The pipe shall be lowered into the trench. The spigot shall be seated into the bell of the adjacent installed pipe, and the pipe lowered into the trench bottom. A shallow bell hole shall be provided in the trench bottom to facilitate the wrapping of the joint.

3. Joint Assembly: The pipe joint shall then be made up as described herein.

4. Adjustment of Polyethylene Encasement: The sling shall be removed from the center of the pipe and hooked into the bell cavity. The bell shall be raised approximately 12 inches and the tube of polyethylene film slipped along the full length of the pipe barrel. Enough of the film shall be left bunched up, accordion fashion, at each end of the pipe to overlap the adjoining pipe about 1 foot. Care shall be taken to ensure that soil that adheres to the pipe is removed as the polyethylene film is placed around the pipe.

5. Overlapped Joints: To make the overlapped joint wrap, the film shall be pulled over the bell of the pipe, folded around the adjacent spigot, and wrapped with about three circumferential turns of the plastic adhesive tape in order to seal the tube of film to the pipe. The tube on the adjacent pipe shall be then pulled over the first wrap on the pipe bell and sealed in place behind the bell, using about three circumferential turns of the polyethylene adhesive tape.

6. Attachment of Encasement: The resulting loose wrap on the barrel of the pipe shall be pulled snugly around the barrel of pipe, the excess material folded over the top and the fold held in place by means of short strips of 2-inch, 10-mil polyethylene adhesive tape at intervals 3 feet apart along the pipe barrel.

## D. Flanged Connections

Flanged pipe and fittings shall be shop fabricated, not field fabricated. Threaded flanges shall comply with AWWA C115 and shall be individually fitted and machine tightened in the shop.

## E. Cathodic Protection and Joint Bonding

All ductile iron pipes shall be joint bonded at a minimum. Ductile iron pipes specified or shown on the plans to be cathodically protected shall be completed in accordance with Section 16640, Cathodic Protection and Joint Bonding.

**END OF SECTION**

# SECTION 15057

# COPPER PIPE AND FITTINGS

## PART 1 - GENERAL

### A. Description

This section describes materials, installation, and testing of copper and brass pipe, and copper, brass and bronze fittings and appurtenances.

### B. Related Work Specified Elsewhere

1. Trenching, Backfilling, and Compacting: 02223

2. Painting and Coating: 09900

3. Hydrostatic Testing of Pressure Pipelines: 15042

4. Installation of Pressure Pipelines: 15051

5. Manual Valves: 15100

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300 and the following:

2. Submit detailed layout if copper pipe runs exceed 50 lineal feet.

3. Submit catalogue order sheets for materials of pipe, flanges, flange insulation kits, companion flanges and unions, showing metal composition and conformance to industry standards (ASTM, etc.) specified.

## PART 2 - MATERIALS

### A. Copper Pipe and Tubing

Copper piping shall conform to ASTM B 88. Copper pipe and tubing shall be cylindrical, of uniform wall thickness, and shall be free from any cracks, seams, or other defects. Piping located above floors or suspended from ceilings shall be Type L. Piping buried or located beneath floor slabs shall be Type K. Copper pipe shall be as manufactured by Halstead, Mueller, or for contracts between District and Contractor, approved equal.

## B. Copper Fittings

Soldered copper fittings are for above ground use only and shall conform to ASTM B 75 and ANSI B16.22. Fittings 3/8-inch and smaller may have compression joint or flared end connections for non-buried applications.

## C. Solder

Solder shall be tin-silver solder conforming to ASTM B 32, latest revision, Grade Sn94, Sn95 or Sn96. Cored solder shall not be used. Solder and flux used in joints of potable waterlines shall contain no more than 0.2 percent lead.

## D. Brass Pipe and Nipples

Short threaded nipples and brass pipe shall conform to ASTM B 43, regular wall thickness, except that nipples and pipe of sizes 1 inch and smaller shall be extra strong. Threads shall conform to ANSI B1.20.1. Brass material shall conform to ANSI/AWWA Standard C800, latest revision, with a maximum lead content of 0.25% by average weight.

## E. Appurtenances

1. General: All items manufactured of bronze shall conform to ASTM B62, "Composition Brass or Ounce Metal Castings." All items manufactured of brass shall conform to ANSI/AWWA Standard C800, latest revision, with a maximum lead content of 0.25% by average weight.

2. Service Saddles: Service saddles shall be tapped with a female iron pipe thread outlet. The seal with the pipe outer wall shall be either a rubber gasket or an O-ring. Service saddles shall be as manufactured by Jones, Mueller, Ford, or for contracts between District and Contractor, approved equal.

    a. Service saddles shall be the double strap type for all sizes of asbestos-cement or ductile iron pipe. The straps (or bails) shall be flat and shall be manufactured of Everdur or Silnic bronze or stainless steel.

    b. Service saddles for C900 PVC pipe shall be cast in two sections for pipe up to and including 8-inches in diameter. Service saddles for use on 10-inch and 12-inch diameter C900 PVC pipe may be cast in two or three sections. Each saddle shall accurately fit the contour of the pipe O.D. without causing distortion of the pipe. The sections shall be securely held in place with Type 316 stainless steel hex-head screws or bolts. Casting sections may be hinged and secured with stainless steel pins. The casting sections shall be tapped to receive the screws or bolts.

c. Repair saddle may be used for asbestos cement pipe when upsizing an existing service line.

3. Corporation Stops: The inlet fitting of the corporation stop shall be a male iron pipe thread when used with a service saddle and the outlet connection shall be a pack joint compression type. Corporation stops shall be of the ball valve type as manufactured by Jones, Mueller, Ford, or for contracts between District and Contractor, approved equal. Insulated corporation stops shall be used on ductile iron and steel pipelines. See Standard Drawings W-1, W-1A and W-2.

4. Angle Meter Stops: The inlet connection of the angle meter stop shall be a pack joint compression type and the outlet fitting shall be a meter flange or meter swivel nut. The inlet and outlet shall form an angle of 90 degrees on a vertical plane through the centerline of the meter stop. A rectangular lug and lock wing shall be provided on the top of the fitting to operate the shutoff mechanism. Two-inch angle meter stops shall be with "slotted" holes for 2-inch meters. Angle meter stops shall be as manufactured by Jones, Mueller, Ford, or for contracts between District and Contractor, approved equal.

5. Service Valve: Service valves shall be “ball valve” type, manufactured of brass or bronze with a lever-type turn handle. The valve shall have a meter swivel nut inlet connection and a female iron pipe thread outlet connection for the 1-inch meters. The valve shall have a meter flange inlet connection and a female iron pipe thread outlet connection for the 1½-inch and 2-inch meters. Insulated customer service valves shall be used on metallic customer service lines. Service valves shall be manufactured by Ford, or for contracts between District and Contractor, approved equal. See Standard Drawings W-1, W-1A and W-2.

## F. Insulating Bushings and Unions

Pipe fittings, and appurtenances (air vacs, pressure gauges, etc.) made of dissimilar metals shall be isolated from each other by means of nylon insulating pipe bushings, insulating unions, or insulating couplings. Insulating bushings, unions, and couplings shall be as manufactured by Pipeline Coating and Engineering Company, Smith-Blair, Pipe Seal and Insulator Company, or for contracts between District and Contractor, approved equal. For applications where pipeline pressures exceed 150 psi, and where the pipe tap for the appurtenance into the main is larger than 1-inch in diameter, a 2½-inch extra heavy carbon steel coupling shall be provided as the outlet, and the fitting/ appurtenance shall be isolated from the main by means of a 2-inch Type 316 stainless steel bushing, 2-inch Type 316 stainless steel nipple, and 2-inch stainless steel ball valve.

## G. Flanges, Gaskets, Bolts and Nuts

1. Flanges for Valves and Fittings: Copper pipe shall be connected to flanged valves and fittings with bronze flanges conforming to ANSI B16.24, Class 125

or Class 150, to match the connecting flange. Solder end companion flanges shall be used for copper and thread companion flanges shall be used for brass, bronze or stainless steel pipe connections.

2. Gaskets: Gaskets for flanged-end fittings shall be made of synthetic rubber binder and shall be full-face, 1/8-inch thick Johns-Manville 60, John Crane Co. "Cranite", or for contracts between District and Contractor, approved equal.

3. Flanged Connections: All flanged connections shall be made using Type 316 stainless-steel bolts and nuts conforming to ASTM A 193, Grade B8M for bolts and ASTM A 194, Grade 8M for nuts. Washers shall be provided for each nut. Washers shall be of the same material as the nuts.

## H. Union

Unions for copper piping systems (non-buried applications) shall conform to the following. Union shall be the same size as the pipe, and shall be of the three part type, with silver soldered “sweat” hub-end connections. Unions shall be bronze, conforming to ASTM B 61 or B 62. Dielectric unions shall be used when connecting copper pipe to ferrous metals. Unions shall be Mueller H-15403, Jones J-1528, or for contracts between District and Contractor, approved equal.

# PART 3 - EXECUTION

## A. General

Pipe shall be installed without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipments. Pipe hangers and supports, and pipe penetrations through walls, slabs, and floors shall be as detailed on the drawings.

## B. Installing Flange Bolts and Nuts

1. Bolt Thread Lubrication: Bolt threads shall be lubricated with anti-seize compound prior to installation. Anti-seize compound shall be manufactured by Tri-Flow, Permatex or Crouse-Hinds.

2. Flange Alignment: Flanges pipe shall be set with the flange boltholes straddling the pipe horizontal and vertical centerlines.

## C. Installation

1. Related Installation Specification: Pipe shall be installed in accordance with the requirements of Section 15051, Installation of Pressure Pipelines.

2. Pipe/Tubing Preparation: Tubing shall be cut square and burrs removed. Both the inside and outside of fitting and pipe ends shall be cleaned with steel wool

and muriatic acid before soldering. Care shall be taken to prevent overheating (or annealing) of fittings and tubing when making connections. Miter joints shall not be permitted in lieu of elbows. Notching straight runs of pipe in lieu of tees shall not be permitted.

3. Pipe Bends: Bends in soft copper tubing shall be long sweep. Bends shall be shaped with shaping tools. Bends shall be formed without flattening, buckling, or thinning the tubing wall at any point.

4. Brazing: Brazing procedures shall be in accordance with Articles XII and XIII, Section IX, of the ASME Boiler and Pressure Vessel Code. Solder shall penetrate to the full depth of the bell in joints and fittings. Solders shall comply with ANSI B31.3, paragraph 328.

5. Polyethylene Encasement: Buried copper piping shall be encased with a minimum 6-mil-thick polyethylene sleeve. Service saddles shall be wrapped with a minimum 8-mil-thick polyethylene encasement.

6. Pipe Flexibility and Minimum Cover for Service Lines: Buried piping shall be installed with some slack to provide flexibility in the event of a load due to settlement, expansion or contraction. A minimum cover of 30-inches below the finished surface shall be adhered to. The tubing shall be bedded and covered with sand or select material in accordance with Section 02223.

7. One-inch Service Laterals: All 1-inch services shall be installed with soft copper tubing Type K. End connections for the corporation stop, angle meter stop, couplings and angle bends shall be compression type fittings. See Standard Drawing W-1.

8. One-and-a-Half-inch and Two-inch Service Laterals: All 1½-inch and 2-inch size services shall be installed with straight lengths of copper water tube Type K. End connections for the corporation stop and angle meter stop shall be compression type fittings. The 90º fitting shall be compression type and of no-lead to low-lead brass material. See Standard Drawing W-1A and W-2.

## D. Service Saddles

1. Proximity to Valves, Couplings, Joints, Pipe Bells and Fittings: Service saddles shall be no closer than 18-inches to valves, couplings, joints, pipe bells or fittings unless it is at the end of the main. The installation of a service saddle on any machined section of asbestos cement pipe will not be permitted.

2. Pipe Surface Preparation: The surface of the pipe shall be cleaned, smoothed and de-burred to remove all loose material and to provide a hard, clean surface before installing the service saddle.

3. Installation: The service saddle shall be tightened firmly to ensure a tight seal; however, care shall be used to prevent damage or distortion of the pipe by overtightening.

4. Pipe Tap: The tap into the pipe shall be made in accordance with the pipe manufacturer's recommendation.

## E. Pipe Coatings

Buried pipe may be coated with cold applied laminated polyethylene/rubberized bitumen coating, with liquid adhesive prime coat. Minimum total coating thickness shall be 35 mils (7-mil polyethylene backing plus 28-mil rubberized bitumen adhesive). Tape shall be applied in the form of 2 or 4-inch wide tape wrap after the primer has dried. Tape shall be applied spirally with a minimum overlap of ¾-inches for 2-inch wide, and 2-inches for 4-inches wide tape. The primer shall be applied at an average rate of 400 square feet per gallon. Tape shall be Polyguard 600 (35 mil) with Polyguard 600 liquid adhesive primer, or for contracts between District and Contractor, approved equal.

**END OF SECTION**

# SECTION 15064

# PVC PRESSURE DISTRIBUTION PIPE AND FITTINGS

## PART - 1 GENERAL

### A. Description

This section includes materials, installation, and testing of polyvinyl chloride (PVC) pipe for 4-inch through 16-inch diameter domestic water lines and sewer force mains, in accordance with the applicable provisions of AWWA C900, AWWA C905 and AWWA C909.

### B. Related Work Specified Elsewhere

1. Trenching, Backfilling, and Compacting: 02223
2. Chlorination of Water Mains for Disinfection: 15041
3. Hydrostatic Testing of Pressure Pipe: 15042
4. Installation of Pressure Pipelines: 15051
5. Ductile-Iron Pipe and Fittings: 15056
6. Water & Sewer Facilities Identification: 15151

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300 and the following.
2. Submit materials list showing material of pipe and fittings with ASTM reference and grade.

### D. Measurement and Payment

1. Payment for work in this section shall be in accordance with the General Provisions and the following.
2. Payment shall be by the linear foot for each diameter and for each pipe strength designation measured horizontally over the pipe centerline, exclusive of the distance between the inside faces of junctions or other structures.

## E. Delivery, Storage, and Handling

1. Care shall be exercised in handling, loading, unloading, and storing PVC pipe and fittings to avoid distortion, scratches, gouges, dents, and, in particular, scuffing of the ends. Discolored pipe shall be rejected.

2. All plastic pipe and fittings shall be stored under cover in a flat, horizontal position, and protected from the sun and the elements until ready for installation. The covering shall be placed in such a way as to allow adequate air circulation between the cover and the pipe.

3. Plastic pipe shall be transported in a vehicle having a bed long enough to provide support for the full length of the pipe. The shipping company shall protect the loaded pipe to avoid vehicle exhaust during transit.

4. Any length of pipe or fitting that has been damaged or distorted shall be replaced.

5. When work is not in progress, open ends of pipe and fittings shall be securely closed so that no water, earth, or other substances will enter the pipe or fittings.

# PART 2 - MATERIALS

## A. PVC Pipe

1. General: PVC pipe shall be manufactured in accordance with AWWA C900 and AWWA C905. PVCO pipe shall be manufactured in accordance with AWWA C909. All water mains 6-inch through 12-inch diameter shall be PVC C900 Class 305 or PVCO C909 Class 305, unless otherwise noted on the plans. The pipe shall have gasketed bell end or plain end with elastomeric gasketed coupling.

2. Material: Material used to produce the pipe and couplings shall be made from Class 12454-A or B virgin compounds as defined in ASTM D 1784, with an established hydrostatic design basis rating of 4,000 psi for water at 73.4°F (23°C).

3. Pipe Lengths: Laying lengths shall be 20 feet with the manufacturer's option to supply up to 15% random lengths (minimum length 10 feet).

4. Pipe Marking: Each pipe length shall be marked showing the date of manufacture, nominal pipe size and O.D. base, the AWWA pressure class, and the AWWA specification designation (AWWA C900, C905 or C909). For potable water application, the seal of the testing agency that verified the suitability of the material for such service shall be included.

5. Manufacturers: Pipe shall be manufactured by JM Eagle, Westlake, Ipex, Vinyltech, Diamond Plastics, and Westlake Pipe & Fittings, or for contracts between District and Contractor, approved equal.

## B. Fittings

1. Materials: Fittings shall be ductile-iron conforming to Section 15056, Ductile-Iron Pipe and Fittings.

2. Bell Sizes: Bell size shall be for Class 150 and Class 200 iron-pipe-size equivalent PVC pipe, including the rubber-ring retaining groove.

3. Reference Standard: All castings shall be marked "DI" or "Ductile" and ANSI/AWWA C153/A21.53.

## C. Rubber Rings

Rubber rings for use in the PVC pipe, couplings and fittings shall conform to the requirements of ASTM F477. Rubber rings shall be stored and protected in a manner to prevent deterioration.

## D. External Restraint System

Restrained joints shall be provided by a clamping ring and an additional ring designed to seat on the bell end of the pipe. The rings shall be connected with T-Head bolts or rods. Restraining devices shall provide full (360 degree) support around the circumference of the pipe. MEGALUG® or approved equal mechanical joint restraints are allowed on C900 PVC pipe, provided that they have pads for a distributed no point load. Series 19MJ00 or approved equal mechanical joint restraints are allowed on C909 PVCO pipe.

Restraining devices shall meet or exceed the requirements of UNI-Bell B-13 "Recommended Standard Performance Specification for Joint Restrainers for Use with PVC Pipe" or ASTM F1674 "Standard Test Method for Joint Restraint Products for Use With PVC Pipe."

Restraining devices shall be UNI-Flange Series 1500 or approved equal with stainless steel bolts. External Restraint System shall be thoroughly coated with NO-OX-ID grease, or approved equal, prior to backfill.

## E. Service Saddles

Service saddles shall be designed for use on C900 and C905 PVC pipe and shall conform to the requirements of Section 15057, Copper Pipe and Fittings. Refer to the YLWD Standard Drawings.

# PART 3 - EXECUTION

## A. General

1. Related Installation Specification: PVC pipe shall be installed in accordance with the requirements of Section 15051, Installation of Pressure Pipelines.

2. Tie-Ins: High deflection repair couplings may be used for tie-ins.

3. Restrictions: When pipe is to be installed in new streets or when street improvements require placement and/or replacement of curbs, piping shall not be installed until new curbs are in place, unless special approval by the District is obtained. If any curbing is damaged during piping installations, the damaged portions shall be repaired or replaced to the satisfaction of the agency having jurisdiction.

4. Closure Sections: Where closure sections are required, the sections shall be installed in accordance with the applicable sections of these specifications. Closures shall be made using gasketed-PVC closure collars.

5. Curved Alignment: For integral bell PVC pipe, the minimum radius curves obtained by deflecting joints shall not exceed the manufacturer's recommendation. Pipe may not be offset to a degree such that the spigot end of the pipe deflects (touches) against the end of the pipe bell. Pipe sections shall not be bent to achieve a curve.

   For curves of smaller radius, ductile-iron fittings shall be used. High deflection couplings may be used for angles of 5° or less.

## B. Installation

1. Pipe Cutting: When pipe is cut and is to be joined to a ductile-iron fitting or another piece of pipe, the end shall be beveled in the field or shop to create a beveled end equal in workmanship to the machined ends of the pipe as furnished by the manufacturer. Such machining shall not result in undercutting the wall thickness and must be approved by the District Representative before installation.

2. Joints: Connecting parts of pipe, rings, couplings, and castings shall be cleaned before assembly. After bearing has been obtained, couplings shall be

assembled in a workmanlike manner. The use of excessive lubricant will not be permitted, and the assembly of the couplings and rings shall be in accordance with the manufacturer's recommendations. Lubricant and rubber rings shall be supplied by the pipe manufacturer. All fittings and valves shall have joints that are compatible for use with ductile iron O.D. PVC pipe.

3. Pipe Marking: Pipe shall be installed with pipe marking facing up, for inspection purposes.

## C. Pipe Identification

Detectable warning tape shall be installed on all potable PVC water piping in accordance with Section 15151, Water and Sewer Facilities Identification.

**END OF SECTION**

# SECTION 15076

# CEMENT-MORTAR LINED AND COATED STEEL PIPE

## PART 1 - GENERAL

### A. Description

This section describes materials, fabrication, installation, and testing of cement-mortar lined and coated steel pipe, in accordance with the applicable requirements of AWWA C200, C205, and C208.

### B. Related Work Specified Elsewhere

1. Trenching, Backfilling and Compacting: 02223
2. Painting and Coating: 09900
3. Chlorination of Water Mains for Disinfection: 15041
4. Hydrostatic Testing of Pressure Pipelines: 15042
5. Installation of Pressure Pipelines: 15051
6. Cathodic Protection and Joint Bonding: 16640

### C. Reference Specification, Codes, and Standards

Commercial Standards:

| | |
|---|---|
| ANSI/ASTM A 139 | Specification for Electric Fusion (Arc) Welded Steel Pipe (Sizes 4-in and Over). |
| ANSI/ASTM E 165 | Methods for Liquid Penetrant Inspection. |
| ANSI/AWWA C200 | Steel Water Pipe 6 In and Larger. |
| ANSI/AWWA C205 | Cement Mortar Protective Lining and Coating for Steel Water Pipe 4 Inch and Larger Shop Applied. |
| ANSI/AWWA C206 | Field Welding of Steel Water Pipe. |
| ANSI/AWWA C208 | Dimensions for Fabricated Steel Water Pipe Fittings. |
| ANSI/AWWA C602 | Cement Mortar Lining of Water Pipelines 4-In (100 |

| | |
|---|---|
| | mm) and Larger In Place. |
| ASTM A 36 | Specification for Structural Steel. |
| ASTM A 283 | Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes, and Bars. |
| ASTM A 570 | Specification for Hot Rolled Carbon Steel Sheet and Strip, Structural Quality. |
| ASTM A 572 | Specification for High Strength Low Alloy Columbium Vanadium Steels of Structural Quality. |
| ASTM C 150 | Specification for Portland Cement. |
| AWWA M-11 | Steel Water Pipe - A Guide for Design and Installation. |

**D. Submittals**

1. Shop Drawings: The Contractor shall submit shop drawings of pipe and fittings in accordance with the requirements in Section 01300, "Contractor Submittals," and the following supplemental requirements as applicable:

   a. Dimensional drawings of all pipe valves, fittings, and appurtenances.

   b. Joint and pipe/fitting wall construction details which indicate the type and thickness of cylinder; type and thickness of lining and coating, the position, type, size, and area of reinforcement; manufacturing tolerances; and all other pertinent information required for the manufacture of the product. Joint details shall be submitted where deep bell or butt strap joints are required for control of temperature stresses.

   c. Fittings and specials details such as elbows, wyes, tees, outlets, connections, handholes, test bulkheads, cathodic test stations, and nozzles or other specials where shown which indicate amount and position of all reinforcement. All fittings and specials shall be properly reinforced to withstand the internal pressure, both circumferential and longitudinal and the external loading conditions.

   d. Design calculations of each critical section of pipe wall, girth joints, and specials all sufficient to ascertain conformance of pipe and fittings.

   e. Material lists and steel reinforcement schedules which include and describe all materials to be utilized.

   f. Line layout and markings diagrams which indicate the specific number of each pipe and fitting and the location of each pipe and the direction of each fitting in

the completed line. In addition, the line layouts shall include: the pipe invert station and elevation at all changes in grade or horizontal alignment; the station and invert elevation to which the bell end of each pipe will be laid; all elements of curves and bends, both in horizontal and vertical alignment; and the limits of each reach of welded joints and concrete encasement.

g. Full and complete information regarding location, type, size, and extent of all welds shall be shown on the shop drawings. The shop drawings shall distinguish between shop and field welds. Shop drawings shall indicate by welding symbols or sketches the details of the welded joints, and the preparation of parent metal required to make them. Joints or groups of joints in which welding sequence or technique are especially important shall be carefully controlled to minimize shrinkage stresses and distortion.

h. Locations of manholes and other points of access.

i. Location of valves and other mechanical equipment.

j. Location of cathodic test stations.

k. Location of bulkheads and butt straps for field hydrostatic testing.

l. Detail drawings of fittings, joints, butt straps and bulkheads.

2. Certifications: The Contractor shall furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this Section of the Specifications, as specified in ANSI/AWWA C200 and C205, respectively, and the following supplemental requirements:

a. Physical and chemical properties of all steel.

b. Physical properties of elastomeric material (rubber) used as gaskets.

c. Hydrostatic test reports.

d. Results of production weld tests.

e. NSF Standard 61 certification for cement mortar lining.

3. All expenses incurred in making samples for certification of tests shall be borne by the Contractor.

## E. Quality Assurance

1. Inspection: All pipe shall be subject to inspection at the place of manufacture of the pipe shall be tested in accordance with the requirements of ANSI/AWWA

C200 and C205, as applicable. The Contractor shall notify the District no less than 14 calendar days prior to the start of any phase of the pipe manufacture. The Contractor shall pay for all trip expenses related to the pipe inspection.

2. Tests: Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of ANSI/AWWA C200 and C205, as applicable.

    a. After the joint configuration is completed and prior to lining with cement mortar, each length of pipe of each diameter and pressure class shall be shop tested and certified to a pressure of at least 80 percent of the yield strength of the pipe steel.

    b. In addition to the tests required in ANSI/AWWA C200, weld tests shall be conducted on each 5,000 feet of production welds and at any other times there is a change in the grade of steel, welding procedure, or welding equipment.

3. The Contractor shall perform said material test at no additional cost to the District, including all trip expenses. The Engineer shall have the right to witness all testing conducted by the Contractor; provided, that the Contractor's schedule is not delayed for the convenience of the Engineer.

4. In addition to those tests specifically required, the Engineer may request additional samples of any material including mixed concrete and lining and coating samples for testing by the Owner. The additional samples shall be furnished at no additional cost to the Owner.

5. Welding Requirements: All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/ASME B31.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.

6. Welder Qualifications: All welding shall be done by skilled certified welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/ASME B31.1 by an independent local, approved testing agency not more than 6 months prior to commencing work on the pipeline. Machines and electrodes similar to those used in the Work shall be used in qualification tests. The Contractor shall furnish all material and bear the expense of qualifying welders.

## PART 2 - PRODUCTS

### A. General

1. Mortar lined and mortar coated steel pipe shall conform to ANSI/AWWA C200 and C205, subject to the following supplemental requirements. The pipe shall be of the diameter and class shown, shall be furnished complete with rubber gaskets or welded joints, as indicated in the Contract Documents, and all specials and bends shall be provided as required. The inside diameter after lining shall not be less than the nominal diameter specified or shown. Each length of straight pipe and each special shall be plainly marked at the bell end to identify the design pressure or head, the steel wall thickness, and the date of manufacture.

2. Markings: The Contractor shall legibly mark all pipes and specials in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. All special pipe sections and fittings shall be marked at each end with top field centerline. For beveled pipe, the degree of bevel and the point on the circumference to be laid uppermost shall be shown.

3. Handling and Storage: The pipe shall be handled by use of wide slings, padded cradles, or other devices, acceptable to the Engineer, designed and constructed to prevent damage to the pipe coating/exterior. The use of chains, hooks, or other equipment which might injure the pipe coating/exterior will not be permitted. Stockpiled pipe shall be suitably supported and shall be secured to prevent accidental rolling. All other pipe handling equipment and methods shall be acceptable to the Engineer. All ends of pipe to be sealed with polywrap.

4. The Contractor shall be fully liable for the cost of replacement or repair of pipe which is damaged.

5. Stockpiled pipe shall be supported on sand or earth beams free of rock exceeding 3 inches in diameter. The pipe shall not be rolled and shall be secured to prevent accidental rolling.

6. Strutting: Adequate strutting shall be provided on all specials, fittings, and straight pipe so as to avoid damage to the pipe and fittings during handling, storage, hauling, and installation. For mortar lined or mortar coated steel pipe, the following requirements shall apply:

    a. The strutting shall be placed as soon as practicable after the mortar lining has been applied and shall remain in place while the pipe is loaded, transported, unloaded, installed and backfilled at the jobsite.

    b. The strutting materials, size and spacing shall be adequate to support the earth backfill plus any greater loads which may be imposed by the backfilling and compaction equipment.

c. Any pipe damaged during handling, hauling, storage, or installation due to improper strutting shall be repaired or replaced.

d. The details of the strutting assembly shall be submitted for review by the Engineer prior to the start of pipe manufacture.

7. Laying Lengths: Maximum pipe laying lengths shall be 40 ft with shorter lengths provided as required.

8. Offset Tolerances: For pipe wall thickness of 3/8-inch or less, the maximum radial offset (misalignment) for submerged arc and gas metal arc welded pipe shall be 0.1875 times the pipe wall thickness or 1/16-inch, whatever is larger. For pipe wall thickness of greater than 3/8-inch, the maximum radial offset shall be 0.1875 times the wall thickness or 5/32-inch, whichever is smaller.

9. Lining: The pipe lining shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness.

10. Bonding and Electrical Conductivity: All unwelded pipe joints shall be bonded for electrical conductivity in accordance with the details shown.

11. Closures and Correction Pieces: Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing shown on the Drawings. The locations of correction pieces and closure assemblies are shown on the Drawings. Any change in location or number of said items shall be acceptable to the Engineer.

## B. Pipe Design Criteria

1. Cylinder Thickness for Internal Pressure: For resistance to internal pressure, the thickness of the steel cylinder shall not be less than the greater of that determined by the following 2 formulas:

Where: T=Steel Cylinder thickness in inches
D=Outside diameter of steel cylinder in inches
$P_w$=Design working pressure in psi
$P_t$=Design transient pressure in psi
Y=Specified minimum yield point of steel in psi
$S_w$=Safety factor of 2.0 at design working pressure
$S_t$=Safety factor of 1.5 at design transient pressure

$$T = \frac{P_W \frac{D}{2}}{\frac{Y}{S_W}} \quad \text{or} \quad T = \frac{P_t \frac{D}{2}}{\frac{Y}{S_t}}$$

2. Unless otherwise specified, $P_w$ shall be assumed to equal the pipe class and $P_t$ shall be assumed to equal 1.33 $P_w$. In no case shall the design stress ($Y/S_w$) exceed 16,500 psi at design working pressure, $P_w$, nor shall the design stress ($Y/S_t$) exceed 22,000 psi at design transient pressure, $P_t$, nor shall the steel shell thickness be less than 0.25-inch.

3. Cylinder Thickness for External Load: Upon determination of cylinder thickness for internal pressure, deflection of the pipe shall be checked by the following formula:

$$Defl_x = \frac{DKWr^3}{EI + 0.0614E'r^3}$$

Where:

$Defl_x$ = Vertical deflection of pipe in inches, not to exceed 0.015 the nominal diameter.

D = Deflection lag factor 1.25

K = Bedding constant 0.1

(1) W = Vertical load on pipe, lb/in

r = Mean radius of pipe shell, inches

(2) EI = Pipe wall stiffness, lb in

E' = Modulus of soil reaction, $lb/in^2$ [1100 for 90 percent Standard Proctor; 1500 for 95 percent Standard Proctor; 2500 for 100 percent Standard Proctor, i.e., cement, crushed rock]

Note (1): For depths of cover of 10 feet or greater, the earth load shall be computed assuming the trench/embankment condition as applicable. For depths of cover of less than 10 feet, HS-20 live load shall be included. For depths of cover of 3 feet or less, HS-20 live load plus impact shall be included. The determination of live load and impact factors shall be as recommended by AASHTO in "Standard Specifications for Highway Bridges."

Trench Condition:

$W_d = C_d w B_d^2$

Where:

$W_d$ = Earth Load in pounds per linear foot
$C_d$ = Calculation Coefficient
Ku' = 0.13
w = 120 lb/ft$^3$
$B_d$ = Trench width at top of pipe, feet

Positive Projecting Embankment Condition:

$W_c = C_c w B_c^2$

Where:

$W_c$ = Earth Load in pounds per linear foot
$C_c$ = Calculation Coefficient (based on $r_{sd}P$ of 0.25)
Ku = 0.19
w = 120 lb/ft$^3$
$B_c$ = Outside diameter of pipe, feet

Note (2): Based on the sum of the pipe wall stiffness, EI, mortar coating, and steel cylinder assuming that it acts as a three part laminar ring which considers no bond between the steel cylinder and the applied lining and coating. The term "pipe wall stiffness" as used herein is defined as EI, where "E" is the modulus of elasticity (E=30,000,000 psi for steel and E=4,000,000 psi for mortar) and "I" is the transverse moment of inertia per unit length of pipe wall, the factors in the foregoing expression to be dimensionally compatible.

4. If the calculated deflection, $Defl_x$, exceeds 0.015 times the nominal diameter, the composite pipe section shall be thickened or the quality of pipe zone backfill shall be improved to achieve a higher soil modulus (e.g., lean concrete, soil/sand cement, crushed rock).

5. Welding of Joint Rings to Resist Thrust: Where steel pipe with field welded separate formed joint rings are used for thrust restraint, the joint rings shall be welded to the cylinder with double fillet welds.

## C. Materials

1. Cement: Cement for mortar shall conform to the requirements of ANSI/AWWA C205; provided, that cement for mortar coating shall be ASTM C150, Type V, and mortar lining shall be ASTM C150, Type II or V. A fly ash or pozzolan shall not

be used as a cement replacement.

2. Steel Pipe

   a. Steel for Cylinders and Fittings: Pipe manufactured under ANSI/AWWA C200 shall be fabricated from sheet conforming to the requirements of ASTM A 570, Grades 30, or 33, or from plate conforming to the requirements of ASTM A 36, A 283, Grades C or D. All longitudinal and girth seams, whether straight or spiral, shall be butt welded using an approved electric fusion weld process.

   b. All steel used for the fabrication on pipe shall have a maximum carbon content of 0.25 percent and shall have a minimum elongation of 22 percent in a 2-inch gage length.

   c. Thickness of the pipe shall be schedule 40 with a minimum wall thickness of 0.250-inches and as specified herein. Pipe shall conform to AWWA C200, AWWA M11.

## D. Specials and Fittings

1. Definition: A fitting shall be defined as a piece of pipe other than a straight full length joint. Elbows, manhole sections, reducers, and sections of pipe with outlets shall be considered fittings.

2. Pressure Rating: Fittings 4 through 10-inches diameter shall be designed for 250 psi and conform to ANSI B16.9. Fittings 12-inches diameter and larger shall comply with AWWA C208. Note the minimum plate thickness required for Section C.2.c herein, above.

3. Materials: Material for fittings 4 through 10-inches shall comply with ASTM A 234, Grade WPB. Material for fittings larger than 10-inches but less than or equal to 30-inches in diameter shall be the same as the pipe or shall comply with ASTM A 283 (Grade D), ASTM A 36, or ASTM A 570 (all grades). Cement-mortar lining and I.D. dimensions shall be the same as the specified pipe.

4. Allowable Stresses: Allowable circumferential stress at the design internal pressure shall not be greater than 40% of minimum yield stress. Minimum wall thickness of steel fitting shall be the same as the pipe of same size per ANSI B36.10 and as required in Section C.2.c herein, above.

5. Grooved End Fittings: Fittings smaller than 24-inches diameter with grooved ends shall have square cut grooves, flexible type, with dimensions as shown in AWWA C606, Table 3. Steel wall thickness shall be standard weight, ANSI B36.10. Cement-mortar lining and I.D. dimensions shall be the same as for the specified pipe.

6. Welding Fittings: Welding fittings shall be standard weight, Tube Turn, or approved equal.

## E. Flanges

Flanges shall be AWWA C207, Class D, flat face, except where Class E or Class F flanges are required.

## F. Bolts, Nuts, and Gaskets for Joints and Flanges

Rubber gaskets shall be furnished for all joints, along with other parts, including flange gaskets, bolts, nuts, washers, jumper rods, and flange insulation kits. One bolt/gasket set shall be provided for each flange.

1. Materials: Buried nuts and bolts for flanges shall be Type 316 stainless steel conforming to ASTM A 193, Grade B8M for bolts, and ASTM A 194, Grade 8M for nuts. All other nuts and bolts shall be Grade B7 zinc-plated.

2. Washers: A washer shall be provided for each nut. Washers shall be of the same material as the nuts.

3. Gaskets: Gaskets shall be composed of synthetic fiber with rubber binder and shall be full-faced, 1/16-inch-thick Garlock 3400, Anchor 441, or approved equal, conforming dimensionally to ANSI B16.21.

## G. Grooved-End Couplings

Grooved-end couplings shall be malleable iron, ASTM A 47, or ductile iron, ASTM A 536. Bolts shall conform to ASTM A 183, 110,000 psi tensile strength. Gaskets shall be EPDM and shall conform to ASTM D 2000. Couplings for pipe 24-inches in diameter and smaller shall be flexible type, square cut groove, per AWWA C606, and shall be Victaulic Style 77, Gustin-Bacon Figure 100, or approved equal.

## H. Outlets

1. Outlets 2-inches in Diameter and Smaller: Outlets of sizes 2-inches in diameter and smaller shall be of the thredolet type, per AWWA Manual M-11, Figure 13.23. Outlets shall be 3,000 pound WOG forged steel per ASTM A 105 or ASTM A 216, Grade WCB. Threads shall comply with ASNI B2.1. Outlets shall be Bonney Forge Co. "Thread-o-let," Allied Piping Products Co. "Branch-let," or approved equal.

2. Outlets larger than 2-inches in Diameter: For outlets larger than 2-inches in diameter, flanged tees shall be used.

## I. Design of Fittings

1. Dimensions shall be per AWWA C208.

2. Allowable circumferential stress at the design internal pressure shall not exceed 40% of minimum yield stress.

3. Outlet reinforcement at branches and openings shall be determined by the procedure given in ANSI B31.3, paragraph 304.3, and Appendix H. If reinforcement is required, it shall be accomplished as described below.

   a. The type of reinforcement for fittings with outlets shall be selected from the following table:

| R | Type of Reinforcement |
|---|---|
| Max. 0.5 | Collar |
| Max. 0.7 | Wrapper Plate |
| To 1.0 | Crotch Plate |

$$\text{Calc. } R = \frac{\text{I.D. outlet}}{\text{I.D. main run} \times \sin B}$$

   Where B = Angle between the longitudinal axis of the main run and the branch.

   b. For collar reinforcement, select an effective shoulder width "W" of a collar from the inside surface of the steel outlet to the outside edge of the collar, measured on the surface of the cylinder of the main run, shall be selected such that:

$$W = (1/3 \text{ to } 1/2) \times \frac{\text{I.D. outlet}}{\sin B}$$

   The minimum thickness "T" of the collar is determined by:

$$T = \frac{P \times \text{I.D. main run} \times \text{I.D. outlet} \times (2 - \sin B)}{4 \times F \times W \times \sin B}$$

   Where P = Design internal pressure
   F = Allowable design stress = 40% of minimum yield stress
   B = As in part C.i.

   Collars may be oval in shape or rectangular with rounded corners.

c. For a wrapper plate, the above collar formula shall be used except that the wrapper is of thickness "T", its total width is (2W + ID outlet/sinB), and it wraps entirely around the main pipe.

d. Base crotch plate design on Swanson, H. S. et al., DESIGN OF WYE BRANCHES FOR STEEL PIPES, summarized in AWWA Manual M 11.

e. Long Radius Curves and Vertical Curves: For curved alignment, straight or beveled pipe of normal or one-half normal lengths pulled partially open on one side of the joint may be used with a welded mitered bend of up to 10 degrees next to the joint ring. Pipes with a bend in excess of 10 shall be designed as fittings.

Joints shall not be pulled more than one-half of the watertight extensibility provided by the bell and spigot design.

## J. Design Of Pipe

1. General: The pipe furnished shall be steel pipe, mortar lined and mortar coated, with rubber gasketed or field welded joints as shown. The pipe shall consist of a steel cylinder, either shop lined or lined in place with portland cement mortar with an exterior coating of cement mortar.

2. The pipe shall be designed, manufactured, tested, inspected, and marked according to applicable requirements previously stated and except as hereinafter modified, shall conform to ANSI/AWWA C200.

3. Pipe Dimensions: The pipe shall be of the diameter and class shown. The minimum steel cylinder thickness for each pipe size shall be as specified or shown.

4. Fitting Dimensions: The fittings shall be of the diameter and class shown, dimensions shall be per AWWA C208.

5. Shop Testing or Fittings:

   a. Dye Penetrant Test: Seams in fittings which have not been previously shop hydrostatically tested shall be tested by the dye penetrant method as described in ASME Boiler and Pressure Vessel Code Section VIII, Appendix B.

   b. Air-Soap Test: In addition to the dye penetrant method of testing, the air-soap method with air at 5 psi shall be used on joints susceptible to being tested by such a method.
   c. Pressure Test in Lieu of Dye Penetrant Test: In lieu of the dye penetrant method of testing, completed fittings may be hydrostatically tested using the field hydrostatic test pressure or 125% of the design pressure, whichever is higher.

6. Joint Design: The standard field joint for steel pipe shall be either a single welded lap joint or a rubber gasketed joint for all pipe sized up to and including 54-inch

diameter and shall be a single welded lap joint for pipe sizes above 54-inch diameter. Mechanically coupled, or flanged joints shall be required where shown. Butt strap joints shall be used only where required for closures or where shown. The joints furnished shall have the same or higher pressure rating as the abutting pipe.

7. Lap joints prepared for field welding shall be in accordance with ANSI/AWWA C200. The method used to form, shape and size bell ends shall be such that the physical properties of the steel are not substantially altered. Unless otherwise approved by the Engineer, bell ends shall be formed by an expanding press or by being moved axially over a die in such a manner as to stretch the steel plate beyond its elastic limit to form a truly round bell of suitable diameter and shape. Faying surfaces of the bell and spigot shall be essentially parallel, but in no case shall the bell slope vary more than 2 degrees from the longitudinal axis of the pipe.

8. For bell and spigot ends with rubber gaskets, the clearance between the bells and spigots shall be such that when combined with the gasket groove configuration and the gasket itself, will provide watertight joints under all operating conditions when properly installed. The Contractor shall require the pipe manufacturer to submit details complete with significant dimensions and tolerances and also to submit performance data indicating that the proposed joint has performed satisfactorily under similar conditions. In the absence of a history of field performance, the results of a test program shall be submitted. Unless otherwise approved by the Engineer, bell ends shall be formed by an expanding press or by being moved axially over a die in such a manner as to stretch the steel plate beyond its elastic limit to form a truly round bell of suitable diameter and shape. No process will be permitted in which the bell is formed by rolling. Further, unless other approved by the Engineer, spigot ends with rolled gasket grooves shall be formed using dies conforming to the minimum radii specified in Appendix X1 of ASTM A570 and the actual yield strength of the steel used in the spigot rolling operation (i.e., yield strength values in mill certifications and subsequent destructive test results) shall be limited to 42,000 psi.

9. Shop applied interior linings and exterior coatings shall be held back from the ends of the pipe as shown or as otherwise acceptable to the Engineer.

10. Restrained Joints: Where shown restrained joints shall be field welded joints. Designs shall include considerations of stresses induced in the steel cylinder, the joint rings, and any field welds caused by thrust at bulkheads, bends, reducers, and line valves resulting from the design working pressure. For field welded joints, design stresses shall not exceed 50 percent of the specified minimum yield strength of the grade of steel utilized, or 16,500 psi, whichever is less, for the part being examined when longitudinal thrust is assumed to be uniformly distributed around the circumference of the joint. All joints to be field welded for thrust restraint shall have the joint rings attached to the cylinder with double fillet welds.

## K. Cement Mortar Lining

1. Cement Mortar Lining for Shop Application: Except as otherwise provided herein, interior surfaces of all steel pipe, fittings, and specials shall be cleaned and lined in the shop with the lining operation in conformity with ANSI/AWWA C205, and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The lining machines shall be of a type that has been used successfully for similar work and shall be approved by the Engineer. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at delivery to site, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications at no additional cost to the District. Cement mortar lining shall be NSF Standard 61 certified.

2. The minimum lining thickness shall be per AWWA C205:

| Nominal Pipe Diameter (in) | Lining Thickness (in) | Tolerance (in) |
|---|---|---|
| 4-10 | 1/4 | -1/16, +1/8 |
| 11-23 | 5/16 | -1/16, +1/8 |
| 24-36 | 3/8 | -1/16, +1/8 |
| over 36 | 1/2 | -1/16, +3/16 |

3. The pipe shall be left bare where field joints occur as shown. Ends of the linings shall be left square and uniform. Feathered or uneven edges will not be permitted.

4. Defective linings, as determined by the Engineer, shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective linings shall be cut back to a square shoulder in order to avoid feather edged joints.

5. The progress of the application of mortar lining shall be regulated in order that all hand work, including the repair of defective areas is cured in accordance with the provisions of ANSI/AWWA C205. Cement mortar for patching shall be the same materials as the mortar for machine lining, except that a finer grading of sand and mortar richer in cement shall be used when field inspection indicates that such mix will improve the finished lining of the pipe.

6. Protection of Pipe Lining/Interior: For all pipe and fittings with plant applied or cement mortar linings, the Contractor shall provide a polyethylene or other suitable bulkhead on the ends of the pipe and on all special openings to prevent drying out of the lining. All bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

## L. Completion of Interior Joints for Mortar-Lined Pipes 20-Inches In Diameter and Smaller

1. Preparation: A tight-fitting swab or squeegee shall be inserted in the joint end of the pipe to be joined.

2. Application of Cement Mortar: When ready to insert the spigot, the face of the cement mortar lining at the bell shall be coated with a sufficient amount of stiff cement mortar to fill the space between adjacent mortar linings of the two pipes to be joined.

3. Removal of Excess Mortar: Immediately after joining the pipes, the swab or squeegee shall be drawn through the pipe to remove all excess mortar and expel it from the open pipe end.

## M. Pipeline Closure Assemblies

1. General: Pipeline closure assemblies shall be employed to unite sections of pipeline laid from opposite directions; to adjust the field length of the pipeline to meet structures, other pipelines, and points established by design stations; and to close areas left open to accommodate temporary test bulkheads for hydrostatic testing. Either follower ring design or butt strap design shall be used. Follower ring closures shall be installed as recommended by the pipe manufacturer.

2. Butt Straps: Shaped steel butt straps shall be centered over the ends of the pipe sections they are to join. On pipes 39 inches in diameter and smaller, butt straps shall be welded to the outside of the pipes with complete circumferential fillet welds equal in size to the thinnest part being joined. The details shown on the drawings shall be referred to when joining larger pipes.

3. General Requirements for Cement Mortar Lining for Closure Assemblies: Closure assemblies shall be cement-mortar lined to a mortar thickness at least equal to the adjoining standard pipe sections. The steel shall be cleaned with wire brushes and a cement and water wash coat applied prior to applying the cement mortar. Where more than a 4-inch joint strip of mortar is required, welded wire mesh reinforcement having a 2-inch by 4-inch pattern of No. 13 gage shall be placed over the exposed steel. The mesh shall be installed so that the wires on the 2-inch spacing run circumferentially around the pipe. The wires on the 4-inch spacing shall be crimped to support the mesh 3/8 inch from the metal surface. The interior mortar shall have a steel-trowled finish to match adjoining mortar lined pipe sections.

4. Lining Closure Assemblies for Pipes 20-Inches in Diameter and Smaller: For lining of closure assemblies on pipelines 20-inches in diameter and smaller, threaded 4-inch nipples with galvanized plugs shall be provided around the

perimeter of the closure at third-point intervals to facilitate mortar lining of the interior surface.

5. Mortar Coating Exterior Surfaces of Closure Assemblies: The exterior of closure assemblies shall be reinforced with wire mesh as described in Paragraph 3 above. The surface shall be coated with mortar, or a poured concrete encasement to cover all steel to a minimum thickness of 1-1/2 inches. Exterior mortar shall be protected to retard drying while curing. Concrete shall be poured and vibrated on one side of the closure assembly only, until mortar is visible on the opposite side, after which the coating can be completed over the top of the assembly.

## N. Exterior Coating of Pipe

1. Exterior Coating of Exposed Piping: The exterior surfaces of pipe which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of rust inhibitive primer conforming to the requirements of Section 09900, Painting and Coating.

2. Exterior Coating of Buried Piping: All pipe for buried service, including bumped heads, shall be coated with a 1-inch minimum thickness of reinforced cement mortar coating. Unless otherwise shown on the Drawings, exterior surfaces of pipe or fittings passing through structure walls shall be cement mortar coated from the center of the wall or from the wall flange to the end of the underground portion of pipe or fitting. The coating shall be reinforced with a spiral wire reinforcement or welded wire fabric in accordance with ANSI/AWWA C205. The welded wire fabric shall be securely fastened to the pipe with welded clips or strips of steel. The wire spaced 2 inches on centers shall extend circumferentially around the pipe. The ends of reinforcement strips shall be lapped 4 inches and the free ends tied or looped to assure continuity of the reinforcement.

# PART 3 - EXECUTION

## A. Installation of Pipe

1. Handling and Storage: All pipe, fittings, etc., shall be carefully handled and protected against damage to lining and coating/interior and exterior surfaces, impact shocks, and free fall. All pipe handling equipment shall be acceptable to the Engineer. Pipe shall not be placed directly on rough ground but shall be supported in a manner which will protect the pipe against injury whenever stored at the trench site or elsewhere. Pipe shall be handled and stored at the trench site in accordance with the requirements stated in Part 2, herein. No pipe shall be installed when the lining or coating/interior or exterior surfaces show cracks that may be detrimental to the long term integrity of the pipe as determined by the Engineer. Such damaged lining and coating/interior and exterior surfaces, shall be repaired, or a new undamaged pipe shall be furnished and installed at no additional

cost to the District.

2. All pipe damaged prior to acceptance by the District shall be repaired or replaced by the Contractor.

3. The Contractor, shall inspect each pipe and fitting to insure that there are no damaged portions of the pipe. The Contractor shall remove or smooth out any burrs, gouges, weld splatter or other small defects prior to laying the pipe.

4. Before placement of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance, which may have collected thereon and shall be kept clean all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption of work of more than two (2) hours.

5. Pipe Laying: When the pipe is being laid, it shall be turned and placed where possible, so that any slightly damaged portion will be on top. The damaged area shall be repaired for the protection of any exposed steel. All damaged areas shall be repaired using materials and methods acceptable to the Engineer.

6. Pipe shall be laid directly on the bedding material. No blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings. Excavation shall be made as needed outside the normal trench section at fields joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.

7. Each section of pipe shall be laid in the order and position shown on the laying schedule. In laying pipe, it shall be laid to the set line and grade, within approximately 1-inch plus or minus. On grades of zero slope, the intent is to lay to grade.

8. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the Engineer may change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount which will be detrimental to the strength and water tightness of the finished joint.

9. Except for short runs which may be permitted by the Engineer, pipes shall be laid uphill on grades exceeding 10 percent. Pipe which is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement. All bends shall be properly installed as

shown.

10. Struts in pipe smaller than 42 inches may be removed immediately after laying, provided, that the deflection of the pipe during and after backfilling does not exceed that specified. After the backfill has been placed, the struts shall be removed and shall remain the property of the Contractor.

11. Cold Weather Protection: No pipe shall be installed upon a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation. No pipe shall be laid unless it can be established that the trench will be backfilled before the formation of ice and frost occurs.

12. Pipe and Specials Protection: The openings of all pipe and specials where the pipe and specials have been cement mortar lined in the shop shall be protected with suitable bulkheads to maintain a moist atmosphere and to prevent unauthorized access by persons, animals, water or any undesirable substance. The bulkheads shall be so designed to prevent drying out of the interior of the pipe. The Contractor shall introduce water into the pipe to keep the mortar moist where moisture has been lost due to damaged bulkheads.

13. Pipe Cleanup: As pipe laying progresses, the Contractor shall keep the pipe interior free of all debris. The Contractor shall completely clean the interior of the pipe of all sand, dirt, mortar splatter and any other debris following completion of pipe laying, pointing of joints and any necessary interior repairs prior to testing and disinfecting the completed pipeline.

## B. Rubber Gasketed Joints

1. Rubber Gasketed Joints: Immediately before jointing pipe, the spigot end of the pipe shall be thoroughly cleaned, and a clean rubber gasket lubricated with an approved vegetable based lubricant shall be placed in the spigot groove. The volume of the gasket shall be "equalized" by moving a metal rod between the gasket and the spigot ring around the full circumference of the spigot ring. The bell of the pipe already in place shall be carefully cleaned and lubricated with a vegetable based lubricant. The spigot of the pipe section shall then be inserted into the bell of the previously laid joint and telescoped into its proper position. Tilting of the pipe to insert the spigot into the bell will not be permitted. After the pipe units have been jointed, a feeler gage shall be inserted into the recess and moved around the periphery of the joint to detect any irregularity in the position of the rubber gasket. If the gasket cannot be "felt" all around, the joint shall be disassembled. If the gasket is undamaged, as determined by the Engineer, it may be reused, but only after the bell ring and gasket have been relubricated.

## C. Welded Joints

1. General: Field welded joints shall be in accordance with ANSI/AWWA C206.

2. Where exterior welds are performed, adequate space shall be provided for welding and inspection of the joints.

3. During installation of welded steel pipe in either straight alignment or on curves, the pipe shall be laid so that at any point around the circumference of the joint there is a minimum lap of ½-inch and a minimum space of 3/4-inch plus the thickness of the steel pipe wall between the spigot end of the pipe and the nearest tangent to a bell radius.

4. Butt straps, where used or required, shall be a minimum of 6-inches wide, the same thickness as the pipe wall and shall provided for a minimum of 3/4-inch lap at each pipe joint.

5. After the pipe and pipe joints are properly positioned in the trench, the length of pipe between joints shall be backfilled to at least one foot above the top of the pipe. Care shall be exercised during the initial backfilling to prevent movement of the pipe and to prevent any backfill material from being deposited on the joint.

6. Prior to the beginning of the welding procedure, any tack welds used to position the pipe during laying shall be removed. Any annular space between the faying surfaces of the bell and spigot shall be equally distributed around the circumference of the joint by shimming, jacking, or other suitable means. The weld shall then be made in accordance with ANSI/AWWA C206. Where more than one pass is required, each pass except the first and final one shall be peened to relieve shrinkage stresses, and all dirt, slag, and flux shall be removed before the next bead is applied.

7. Qualifications of Procedures and Welders: All welding procedures used to install pipe shall be prequalified under provisions of ANSI/ASME B31.1. Welding procedures shall be required for field attachments and field welded joints.

8. Joints: The pipe ends shall be cut straight on joints where butt straps are used for realignment, adjustment, or deflection, and fillet welds shall be made as shown on the Drawings.

9. Unless double fillet welds are shown on the Drawings, field welded lap joints may, at the Contractor's option, be made on either the inside or the outside of the pipe.

## D. Joint Coating and Lining

1. General: The interior and exterior joint recesses shall be thoroughly wiped clean and all water, loose scale, dirt and other foreign material shall be removed from

the inside surface of the pipe. The cement for joint grout shall be non-shrink grout and shall conform to the Corps of Engineers Specification for Nonshrink Grout, CRD - C588-78. Use a non-gas-liberating type, cement base, premixed product requiring only the addition of water for the required consistency. Grout shall be UPCON High Flow, Master Flow 713, or approved equal. All components shall be inorganic.

2. Joint Coating: After the pipe has been laid and after sufficient backfill has been placed between the joints to hold the pipe securely in place, the outside annular space between pipe sections shall be completely filled with non-shrink grout formed by the use of polyethylene foam lined fabric bands. The grout shall be composed of 1 part cement to not more than 2 parts sand, thoroughly mixed with water to a consistency of thick cream. The grout space prior to filling will be thoroughly mixed with water to a consistency of thick cream. The grout space prior to filling shall be flushed with water so that the surface of the joint to be in contact with the grout will thoroughly moistened when the grout is poured. The joint shall be filled with grout by pouring from one side only, and shall be rodded with a wire or other flexible rod or vibrated so that the grout completely fills the joint recess by moving down one side of the pipe, around the bottom of the pipe and up the opposite side. Pouring and rodding the grout shall be continued to allow completion to allow completion of the filling of the entire joint recess in one operation. Care shall be taken to leave no unfilled space. Grouting of the outside joint spaces shall be kept as close behind the laying of the pipe as possible except that in no case shall grouting be closer than 3 joints of the pipe being laid.

3. Grout Bands (Diapers): The grout bands or heavy duty diapers shall be polyethylene foam lined fabric with steel strapping of sufficient strength to hold the fresh mortar, resist rodding of the mortar and allow excess water to escape. The foam plastic shall be 100 percent closed cell, chemically inert, insoluble in water and resistant to acids alkalies and solvents, and shall be Dow Chemical Company, Ethafoam 222, or equal.

4. The fabric backing shall be cut and sewn into 9-inch wide strips with slots for the steel strapping on the outer edges. The polyethylene foam shall be cut into strips 6 inches wide and slit to a thickness of 1/4-inch which will expose a hollow or open cell surface on one side. The foam liner shall be attached to the fabric backing with the open or hollow cells facing towards the pipe. The foam strip shall cover the full interior circumference of the grout band with sufficient length to permit an 8-inch overlap of the foam at or near the top of the pipe joint. Splices to provide continuity of the material will be permitted. The polyethylene foam material shall be protected from direct sunlight.

5. The polyethylene foam lined grout band shall be centered over the joint space with approximately equal widths extending over each pipe end and securely attached to the pipe with steel straps. After filling the exterior joint space with non-shrink grout, the flaps shall be closed and overlapped in a manner that fully encloses the

grout with polyethylene foam. The grout band shall remain in position on the pipe joint.

6. Joint Lining: After the backfill has been completed to final grade, the interior joint recess shall be filled with non-shrink grout of stiff consistency. The mortar shall be tightly packed into the joint recess and troweled flush with the interior surface, and all excess shall be removed. At no point shall there be an indentation or projection of the mortar exceeding 1/16-inch. With pipe smaller than 24 inches in diameter, before the spigot is inserted into the bell, the bell shall be daubed with non-shrink grout. The spigot end then shall be forced to the bottom of the bell and excess mortar on the inside of the joint shall be swabbed out. GS-79 Extruded Butyl Rubber Pipe Joint Sealant, by General Sealants Inc., may be used instead of mortar.

## E. Installation of Pipe Appurtenances

1. Protection of Appurtenances: Where the joining pipe is concrete or coated with cement mortar, buried appurtenances shall be coated with a minimum thickness of 1-1/2-inch of cement mortar having one part cement to not more than 2 parts plaster sand.

2. Installation of Valves: All valves shall be handled in a manner to prevent any injury or damage to any part of the valve. All joints shall be thoroughly cleaned and prepared prior to installation. The Contractor shall adjust all stem packing and operate each valve prior to installation to insure proper operation.

3. All buried valves shall be coated and protected in accordance with Section 09900, Painting and Coating.

4. All valves shall be installed so that the valves stems are plumb.

5. Installation of Flanged Joints: Before the joint is assembled, the flange faces shall be thoroughly cleaned of all foreign material with a power wire brush. The gasket shall be centered and the connecting flanges drawn up watertight without unnecessarily stressing the flanges. All bolts shall be tightened in a progressive diametrically opposite sequence and torqued with a suitable, approved and calibrated torque wrench. All clamping torque shall be applied to the nuts only.
6. Insulated Joints: Insulated joints and appurtenant features shall be made by the Contractor as shown on the Drawings. The Contractor shall exercise special care when installing these joints to prevent electrical conductivity across the joint. After the insulated joint is completed, an electrical resistance test will be performed by the Owner.

7. Should the resistance test indicate a short circuit, the Contractor shall remove the insulating units to inspect for damages, replace all damaged portions, and reassemble the insulating joint. The insulated joint shall then be retested to assure

proper insulation.

8. Flexible Coupled Joints: When installing flexible couplings, care shall be taken that the connecting pipe ends, couplings and gaskets are clean and free of all dirt and foreign matter with special attention being given to the contact surfaces of the pipe, gaskets and couplings. The couplings shall be assembled and installed in conformity with the recommendation and instruction of the coupling manufacturer.

9. Wrenches used in bolting couplings shall be of a type and size recommended by the coupling manufacturer. Coupling bolts shall be tightened so as to secure a uniform annular space between the follower rings and the body of the pipe with all bolts tightened approximately the same amount. Diametrically opposite bolts shall be tightened progressively and evenly. Final tightening shall be done with a suitable, approved and calibrated torque wrench set for the torque recommended by the coupling manufacturer. All clamping torque shall be applied to the nut only.

10. Upon completion of the coupled joint, the coupling and bare metal of the pipe shall be cleaned, primed and protected in accordance with the requirements of Section 09900, Painting and Coating.

## F. Blowoff Assemblies

1. General: In-line type or end-of-line type blowoff assemblies shall be installed in accordance with the plans at locations noted, and at such additional locations as required by the District for removing water or sediment from the pipeline. See Standard Drawing W-27.

2. Location: The assembly shall be installed in a level section of pipe. The tap for blowoff in the line shall be no closer than 18 inches to a valve, coupling, joint, or fitting unless it is at the end of the main. No tap will be permitted in any machined section of asbestos cement pipe.

## G. Combination Air and Vacuum Release Valves

1. General: Air release valve assemblies and combination air and vacuum valves shall be installed at each point in the pipeline as shown on the drawings or as specified by the District, and in accordance with Section 15089, Air Release and Vacuum Relief Valves and Standard Drawing W-10.
2. Location: 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. No tap shall be permitted in any machined section of asbestos cement pipe.

## H. Aboveground Piping Installation/Support

1. General: Installation of aboveground pipeline materials and appurtenances include requirements for buried pipeline materials and appurtenances as applicable.

2. Supports: All exposed pipe shall be adequately supported with devices of appropriate design. Where details are shown, the supports shall conform thereto and shall be placed as indicated; provided, that the support for all piping shall be complete and adequate as herein specified, whether or not supporting devices are specifically called for. Pipe hangers and supports shall conform to the requirements of the latest editions of the MSS-SP58 and SP69 and ANSI/ASME B31.1.

3. Grooved-End Pipe and Fittings: Grooved-end pipe and fittings shall be installed in accordance with the coupling manufacturer's recommendations and the following:

   a. Loose scale, rust, oil, grease, and dirt shall be cleaned from the pipe or fitting groove. The coupling manufacturer's gasket lubricant shall be applied to the gasket exterior including lips, pipe ends, and housing interiors.

   b. Coupling shall be fastened alternately and evenly until coupling halves are seated.

## I. Disinfection

All potable water pipelines shall be disinfected in accordance with Section 15041 Chlorination of Water Mains for Disinfection.

## J. Testing

All piping shall be hydrostatically pressure tested in accordance with Section 15042, Hydrostatic Testing of Pressure Pipelines.

## K. Corrosion Control

1. Joint Bonding/Electrolysis Test Stations: Except where otherwise specified, all joints shall be bonded in accordance with the standard details and Section 16640, Cathodic Protection and Joint Bonding.. The pipe shall be cleaned to bare bright metal at the point where the bond is installed. In addition, electrolysis test stations shall be installed where shown.

**END OF SECTION**

# SECTION 15089

# AIR-RELEASE AND VACUUM RELIEF VALVES

## PART 1 - GENERAL

### A. Description

This section describes materials and installation of air and vacuum valves, air-release valves, and combination air-release valves.

### B. Related Work Specified Elsewhere

1. Painting and Coating: 09900

2. Hydrostatic Testing of Pressure Pipelines: 15042

3. Manual Valves: 15100

4. Copper Pipe and Fittings: 15057

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300 and the following.

2. Submit manufacturer's catalog data. Show dimensions, materials of construction by ASTM reference and grade, and coatings.

## PART 2 - MATERIALS

### A. Coating

Valves located above ground or in vaults and structures shall be coated in accordance with Section 09900, Painting and Coating. Prime coat shall be applied at the place of manufacture. Color of finish coat shall match the color of the adjacent piping.

### B. Lining

The interior surfaces of air-release and vacuum relief valves shall be coated per Section 09900, Painting and Coating, System G-1. Seating areas and plastic, bronze, stainless steel, or other high alloy parts shall not be coated.

## C. Bolts and Nuts for Flanged Valves

1. Bolts and nuts for flanged valves and flanges shall be Type 316 stainless steel conforming to ASTM A 193, Grade B8M, for bolts and ASTM A 194, Grade 8M, for nuts.

2. Washers: Washers shall be provided for each nut; shall be of the same material as the nuts; and shall be installed adjacent to the nut, between the nut and the flange.

## D. Gaskets

Gaskets for flanged end valves shall be as described in the detailed, individual piping specifications.

## E. Valves

1. Valves shall be manufactured in accordance with AWWA C-512.

2. Air Release Valves, 1-Inch and 2-Inch.

   a. Air-release valves for water service shall function to slowly release pockets of air which accumulate at high points in piping systems. Valves shall have a float-actuated compound lever with linkage mechanism to release air. Float shall withstand an external pressure of 1,000 psig without collapsing.

   b. Air-release valves shall incorporate a body with threaded top cover and replaceable orifice and a synthetic rubber needle or disc actuated by the float and linkage mechanism. Top cover shall include a 1/2-inch threaded outlet with bronze plug. Body shall include a 1/2-inch threaded drain outlet near the bottom with a bronze plug.

   c. Materials of construction for air-release valves for water service shall be as follows:

| Component | Material | Specification |
|---|---|---|
| Body and cover | Ductile iron | ASTM A 536 |
| Float | Stainless-steel | AISI Type 316, ASTM A 240 |
| Linkage, orifice air-release mechanism | Stainless-steel | ASTM Type 316, ASTM A 240 |
| Needle or orifice button | Buna-N | -- |

d. Valves shall be designed for an operating pressure of 150 psi unless otherwise specified by the Engineer. Valves shall be APCO, Val-Matic, Crispin or approved equal.

3. Air and Vacuum Valves, 3-Inch and greater.

a. Air and vacuum valves for water service shall have a float assembly and large venting orifice to exhaust large quantities of air from pipelines when being filled and to admit large quantities of air when pipelines are being drained. The float shall rise with the water level in the valve body to close the orifice by sealing against a synthetic rubber seat. Float shall withstand an external pressure of 1,000 psig without collapsing.

b. Air and vacuum valves 3-inches and smaller shall have 1/2-inch threaded outlets with bronze plugs in the top cover and near the bottom of the valve body. Air and vacuum valves larger than 3-inches shall have a 1-inch threaded drain outlet with bronze plug near the bottom of the valve body and a 1-inch threaded outlet with bronze plug on the side of the valve body above the minimum water level. Float shall be able to withstand an external pressure of 1,000 psig without collapsing.

c. Materials of construction for air and vacuum valves for water service shall be as follows:

| **Component** | **Material** | **Specification** |
|---|---|---|
| Body and cover | Ductile iron | ASTM A 536 |
| Float, guide rod, guide bushings | Stainless-steel | AISI Type 316, ASTM A 240 or A 276 |
| Seat | Buna-N | --- |

d. Valves shall be designed for an operating pressure of 150 psi unless otherwise specified by the Engineer. Valves shall be APCO, Crispin, Val-Matic or approved equal.

4. Combination Air-Release Valves, 1-Inch Through 8-Inch

a. Combination air-release valves for water service shall consist of both an air and vacuum valve and air-release functions contained in one body. The air and vacuum shall serve to release and admit large quantities of air when pipelines are filled and drained. The air-release shall serve to release small quantities of air that accumulate during pipeline operation.

b. Valves shall have a maximum operating pressure of 150 psi or higher. Valves shall be APCO 140C/150C Series; Val-Matic 200C Series, Crispin UL Series, A.R.I. D-040 Series or approved equal.

c. Materials of construction for combination air-release valves shall be as follows:

| Component | Material | Specification |
|---|---|---|
| Body and cover | Ductile iron, cast iron, or reinforced nylon | Ductile iron: ASTM A 536<br>Cast iron: ASTM A126, Class B |
| Float, float arm, poppet | Stainless-steel or foamed polypropylene | Stainless steel: AISI Type 316, ASTM A 240 or A 276<br>Foamed polypropylene: ASTM-1895-89 |
| Seat, orifice button | Buna-N | -- |

## F. Valve End Connections

1. Applications: Valves smaller than 3-inches shall have threaded ends. Valves 3-inches and larger shall have flanged ends.

2. Flanged Connections: Flanges for Class 150 valves shall comply with ANSI B16.1, Class 125. Flanges for Class 300 valves shall comply with ANSI B16.1, Class 250.

3. Threaded Connections: Threaded ends shall comply with ANSI B1.20.1.

## G. Service Piping

Water service piping utilized in the installation of the 2" and smaller combination air and vacuum relief valve shall be Type K copper with bronze accessories per Section 15057, Copper Pipe and Fittings.

## H. Vented Vertical Cover

The vented vertical cover shall be a polyethylene valve enclosure for 1-inch to 3-inch combination air-release valves. The enclosure shall have a bolt down base with removable cover. The cover and base shall be manufactured of polyethylene with UV stabilizers with a minimum 3/16” wall thickness. The cover shall lock to the base with an integral auto-latch and padlock hasp, and shall be manufactured with air vent slots and drainage slots. The polyethylene valve enclosure for the 1-inch combination air-release valves shall be Armorcast Products Company P6002002BB (20” diameter x 36”), Pipeline Products Model #VCAS-1830, in granite color, or approved equal. For

2 to 3 inch combination air-release valves, the polyethylene valve enclosure shall be Armorcast Products Company P6002001BB (24" diameter x 36"), Pipeline Products Model #VCAS-2436, in granite color, or approved equal.

The vented vertical cover for 4-inch or larger combination air-release valves for steel main pipes shall be a steel vented pipe vertical cover, manufactured by Pipeline Products (30" diameter x 36") in gray color, or approved equal.

## PART 3 - EXECUTION

### A. Installation

1. Standard Drawing Reference for Applications on Pipelines Having a Diameter of 10-Inches and Smaller: Air release assemblies and combination air and vacuum valves shall be installed in accordance with Standard Drawing W-10 or W-10A.

2. Tap: 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. No tap shall be permitted in any machined section of asbestos cement pipe.

3. Flanged Connections: Flanges shall be cleaned by wire brushing before installing flanged valves. Flange bolts and nuts shall be cleaned by wire brushing, and threads lubricated with oil and graphite. Nuts shall be tightened uniformly and progressively. If flanges leak under pressure testing, nuts and bolts shall be loosened or removed, the gasket reseated or replaced, the bolts and nuts reinstalled or retightened, and joints retested. Joints shall be watertight.

4. Threaded Connections: 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.

### B. Valve Pressure Testing

Valves shall be tested at the same time that the connecting pipelines are pressure tested. See Section 15042, Hydrostatic Testing of Pressure Pipelines, for pressure testing requirements.

### C. Painting and Coating

The air vacuum relief valve and the steel vented pipe cover shall be painted in accordance with Section 09900, Painting and Coating.

**END OF SECTION**

# SECTION 15100

# MANUAL VALVES

## PART 1 - GENERAL

### A. Description

This section includes materials, testing, and installation of manually operated valves and check valves.

### B. Related Work Specified Elsewhere

1. Painting and Coating: 09900

2. Hydrostatic Testing of Pressure Pipelines: 15042

### C. Submittals

1. Submit shop drawings in accordance with Section 01300 and the following.

2. Submit manufacturer's catalog data and detail construction sheets showing all valve parts and describing material of construction by material and specification (such as AISI, ASTM, SAE, or CDA).

3. Show valve dimensions including laying lengths. Show dimensions and orientation of valve operators, as installed on the valves.

4. Show valve linings and coatings.

## PART 2 - MATERIALS

### A. General

Valves shall be provided complete with operating hand-wheels, chain-wheels, extension stems, floor stands, worm gear operators, operating nuts, chains, and wrenches required for operation. Valves shall have the name of the manufacturer and the size of the valve cast or molded onto the valve body or bonnet or shown on a permanently attached corrosion-resistant plate.

## B. Valve Operators

1. Operators for Exposed Valves Smaller Than 6-Inches: Lever or wrench operators having adjustable, open stop memory positions shall be provided for exposed valves smaller than 6-inches.

2. Operators for Buried and Submerged Valves

   a. Direct acting 2-inch square AWWA operating nuts shall be provided for all buried and submerged valves.

   b. Watertight shaft seals and watertight valve and actuator cover gaskets shall be provided. Totally enclosed operators designed for buried or submerged service shall be provided.

3. Operators for Valves 6-Inches and Larger

   a. Gear operators shall be provided on all butterfly, ball, and plug valves 6-inches and larger. Gear operators for valves 8-inches through 30-inches shall be of the "worm gear" or of the "traveling nut" type. Gear operators for valves 36-inches and larger shall be of the worm gear type.

   b. Gear operators shall be enclosed, suitable for running in grease with seals provided on shafts to prevent entry of dirt and water into the operator. Buried service valves shall be 90% grease packed by AWWA Standards. Gear operators for valves located above ground or in vaults and structures shall have handwheels. Minimum handwheel diameter shall be 12-inches.

   c. Gear operators shall be of the totally enclosed design, proportioned to permit operation of the valve under full operating head in either direction, with a maximum pull of 80 pounds on the handwheel or crank. Operators shall be provided with open and closed position stop limiting devices. Operators shall be of the self-locking type to prevent the valve disc or plug from creeping. Operator components shall be designed to withstand a pull of 200 pounds for handwheel or chainwheel operators between the input and stop limiting devices without damage, and an input torque of 300 foot-pounds for worm gears and 450 foot-pounds for traveling nuts when operating against the stops.

   d. Self-locking worm gears shall be a one-piece design of gear bronze material (ASTM B 427), accurately machine cut. The worm shall be hardened alloy steel (ASTM A 322, Grade G 41500; or ASTM A 148, Grade 105-85), with thread ground and polished. The reduction

gearing shall run in a proper lubricant inside a ductile iron housing. Operators shall be AWWA proof of design compliant and shall be Limitorque Model PT Series, EIM Model WO or WG, or for contracts between District and Contractor, approved equal.

e. Gear operators shall be able to rotate the valve element (disc, plug, or ball) from the fully closed position to fully open position in a number of turns of the operator not fewer than three (3) times the number of diameter inches. Where the number of turns may fall outside of the range for turn limits above, the use of a factory attached spur gear reducer shall be used to provide the appropriate number of rotations from the fully "open" to the fully "closed" position. Spur gear assemblies shall be mounted integrally to the actuator by approved means and shall meet all of the other component and torque requirements listed herein.

4. Operating Torque Requirement for Buried Valves: Operators on buried valves shall be designed to produce the required torque on the operating nut with a maximum input of 150-foot-pounds.

5. Opening Direction: Valve operators, handwheels, or levers shall open by turning counterclockwise.

6. Position Indicators: Valve position indicators shall be provided for all above ground valves.

## C. Valve Boxes and Lids for Buried Valves

1. General: Valve wells shall be 8-inch Schedule 40 PVC pipe, or 8-inch SDR 35 PVC pipe.

2. Valve Box Lids: Valve box lids shall be cast-iron, and shall be designed to rest without a frame on a cast-in-place concrete ring surrounding the valve extension pipe. The lid skirt shall be tapered for a close fit inside the upper sleeve portion of the valve box. The lid skirt shall be a minimum of 3 ½"-inches deep and the nominal 9-inch diameter lid shall have a minimum weight of 13 pounds, unless otherwise noted. Lids for potable water valve boxes shall be circular with the word WATER cast on the lid. See YLWD Standard Drawing W-8.

3. Manufacturers: Valve boxes and lids for potable water lines shall be Jensen Precast HTV10-3 and HTV10-3-CIL4, J&R Concrete Products V3-RT, Eisel Enterprises Inc. 10 Valve Box Series W10VB, or for contracts between District and Contractor, approved equal.

## D. Extension Stems for Buried Valve Operators

Where the depth of the valve is such that its operating nut is more than 84-inches below grade, operating extension stems shall be provided to bring the operating nut to a point 12-inches below the surface of the ground and/or box cover. Extension stems shall be steel, and shall be complete with 2-inch-square operating nut. Stem shall be provided with a 1/8-inch centerguide to keep stem centered. Pinned couplings are not permitted. Extension stems shall conform to Standard Drawing W-9.

## E. Bolts, Nuts, and Gaskets for Flanged Valves

Bolts and nuts for flanged valves shall be described in the detailed individual piping specifications. All nuts, bolts, and washers shall be Type 316 stainless steel.

## F. Painting and Coating

1. Above Ground Valves or Valves in Vaults: Metal valves (except bronze and stainless-steel valves) located above ground or in vaults and structures shall be coated in accordance with Section 09900, System No. C-1. The specified prime coat shall be applied at the place of manufacture. Intermediate and finish coats shall be applied in field. Finish coat shall match the color of the adjacent piping. Handwheels shall receive the same coating as the valves.

2. Buried Valves: Buried metal valves and extension stems shall be coated at the place of manufacture per Section 09900, Painting and Coating. Buried gate valves shall be coated per System No. G-1, and buried butterfly valves, per System No. D-2.

3. Interior Coating: Metal valves 4-inches and larger shall be coated on the interior metal parts, excluding seating areas and bronze and stainless-steel pieces, per Section 09900, Painting and Coating. Gate valve interior shall be coated per System No. G-1, and butterfly valve interior, per System No. D-2. Coating shall be factory applied by the valve manufacturer.

## G. Valves

1. Above Ground Gate Valves 3-Inches and Smaller: Above ground gate valves, 1/4-inch through 3-inches, for water service shall be non-rising stem, screwed bonnet, solid wedge disc type designed for a minimum working pressure of 220 psi. Valves shall have threaded ends. Materials of construction shall be as follows:

| Component | Material | Specification |
|---|---|---|
| Body, bonnet, solid wedge disc type | Bronze | ASTM B62 |
| Stem | Bronze or copper silicon | ASTM B62, B99 (Alloy 651), B584 (Alloy C87600), B371 (Alloy 694) |

Stem material shall have a minimum tensile strength of 60,000 psi and a minimum yield strength of 30,000 psi. Handwheels shall be brass. Packing shall be Teflon asbestos. Valves shall be Crane 438, Stockham 103, or approved equal.

2. Buried Gate Valves Smaller Than 3-Inches: Buried gate valves for air or water service shall be non-rising stem type, ~~double disc~~ solid wedge disc type, parallel seat, and shall be designed for a minimum working pressure of 200 psi. Valves shall have flanged, PVC, or threaded ends as required for the type of pipe used. Materials of construction shall be as follows:

| Component | Material | Specification |
|---|---|---|
| Body, bonnet, operating nut, stuffing box | Cast iron | ASTM A126, Class B |
| Bonnet bolts stuffing box bolts | Steel, cadmium plated | ASTM A307, Grade B; B766, Class 25, Type II |
| Solid wedge disc type Disc, disc nut, disc ring, seat ring | Bronze | ASTM B62 |
| O-ring | Synthetic rubber | ASTM D2000 |
| Stem | Copper silicon or manganese bronze | Copper silicon or ASTM B584, Alloys C86200, C86300, C86400, C87500, or C87600 |

Valves shall be Stockham G-736, G-739, or G-745; Kennedy Figure 597X or 561X; Mueller Series A2380; or approved equal.

3. Resilient Seated Gate Valves, 3-Inches Through 12-Inches: Resilient seated wedge-type, gate valves shall conform to AWWA C509 and the following requirements. Valve shall have a wedge-type resilient seat, fully encapsulated in peroxide-cured EPDM. Valves shall be designed for a minimum working pressure of 200 psi, and shall not leak at that pressure. Valves shall have non-rising stems. Stem nuts shall be independent of the gate and shall be made of solid bronze. All internal working parts, including the stem, shall be all bronze containing not more than 2 percent aluminum or more than 7 percent zinc. Bronze shall be ASTM B62 (85-5-5-5) bronze, except that stem bronze shall

have a minimum tensile strength of 60,000 psi, a minimum yield strength of 30,000 psi, and a minimum of 10 percent elongation in 2-inches. Materials of construction shall be as follows:

| Component | Material | Specification |
|---|---|---|
| Body, operating nut, bonnet, seal plate | Cast iron<br>Ductile iron | ASTM A126, Class B<br>ASTM A536, Grade 65-45-12 |
| Gate | Cast iron<br>Ductile iron | ASTM A126, Class B<br>ASTM A536, Grade 65-45-12 |
| Bonnet and seal plate nuts and bolts | Stainless-steel | ASTM A276, Type 316 |
| O-rings | Synthetic-rubber | ASTM D2000 |

Low friction, torque reduction thrust bearings shall be provided both above and below the stem collar. Stuffing boxes shall be O-ring seal type with two rings located in stem above thrust collar. Each valve shall have a smooth unobstructed waterway free from any sediment pockets. Gates shall be of the wedge-type, encapsulated in peroxide-cured EPDM rubber. Valves shall be Clow 2639/2640, Mueller A2361, American AVK, American Flow Control Series 2500, and M&H Style 4067, or approved equal.

4. Butterfly Valves 4-Inches and Larger, Class 150B: Butterfly valves shall be short body, flanged type, conforming to AWWA C504, Class 150B. Wafer style valves are not permitted. Unless otherwise noted, minimum working differential pressure across the valve disc shall be 150 psi. Valve ends shall be as shown on the drawings; flanged ends shall be Class 125, ANSI B16.1. Valve shafts shall be Type 304 or 316 stainless-steel. Valve shafts shall be stub shaft or one-piece units extending completely through the valve disc. Valve bodies shall be tested at a pressure equal to twice the design working pressure. Gears shall be sized for bi-directional flow at 16 fps and at full rated pressure and differential. Materials of construction shall be as follows:

| Component | Material | Specification |
|---|---|---|
| Body | Cast iron or ductile iron | ASTM A48, Class 40; ASTM A126, Class B; or ASTM A536, Grade 65-45-12 |
| Exposed body cap screws, and bolts, nuts and washers | Stainless-steel | ASTM A276, Type 304 or 316 |
| Solid wedge disc type | Cast iron, ductile iron, or Ni-Resist | ASTM A48, Class 40; ASTM A536, Grade 65-45-12; or ASTM A436, Type 1 |

The rubber seat shall be an integral part of the valve body. Rubber seats fastened to the disc by any means shall not be allowed. Valves shall be Pratt Groundhog, DeZurik BAW, Mueller Lineseal, or approved equal.

5. Ball Valves 2-Inches and Smaller: Ball valves, 2-inches and smaller, for water service at pressure reducing stations etc. shall be stainless steel, and shall be rated at a pressure of 300 psi WOG at a temperature of 150°F. Valves shall have plastic coated lever operators. Valves shall have full bore ports, screwed ends, and non-blowout stems. Materials of construction shall be as follows:

| Component | Material | Specification |
|---|---|---|
| Body, ball, stem | Stainless-steel | Type 316, ASTM A276 |
| Seat, seals | Teflon | |

Valves shall be Stockham Figure S-127 or approved equal.

6. Ball Valves 2-1/2-Inches to 6-Inches: Ball valves 2-1/2-inches to 6-inches shall be rated for a minimum working pressure of 150 psi. Valves shall have flanged ends. Materials of construction shall be as follows:

| Component | Material | Specification |
|---|---|---|
| Body, ball | Ductile iron | ASTM A395, ASTM A445 |
| Stem | Carbon steel | ASTM A216, Grade WCB |
| Seat, seals | Teflon | |

Valves shall be Jamesbury Style 150F, Powell Figure 4222T, or approved equal.

7. Eccentric Plug Valves, 4-Inches Through 12-Inches: Eccentric plug valves, 4-inches through 12-inches shall be of the non-lubricated type with external adjustable packing. Minimum pressure rating shall be 175 psi. Unless noted otherwise on the drawings, ends shall be flanged, Class 125 per ANSI B16.1. Materials of construction shall be as follows:

| Component | Material | Specification |
|---|---|---|
| Body | Cast iron | ASTM A126, Class B |
| Plug | Cast iron, ductile iron, Ni-Resist | ASTM A126, Class B<br>ASTM A536, Grade 65-45-12,<br>ASTM A436 |

Plugs shall be cylindrical with neoprene, Buna N or EPDM facing to provide drip-tight shutoff. Elastomer choice shall be dependent on project conditions. Valve body seats shall have a raised welded-in overlay of not less than 90 percent nickel. Packing shall be replaceable with valve body under full

pressure and with valve in the fully open position. Shaft seals shall be of the multiple V-ring type and shall be externally adjustable and repackable without removing the actuator or bonnet from the valve under pressure. Valves utilizing O-ring seals or non-adjustable packing shall not be acceptable. Plug shall be of the one piece design. Proof of design shall accompany submittals and leak tests shall accompany shipment. The stems shall come equipped with grit extruders. Valves shall be DeZurik PEC, Clow Model F5412 or approved equal.

8. Check Valves 4-Inches and Larger:

a. Swing Check Valves: Swing check valves shall conform to AWWA C508, and shall be iron body, bronze mounted with the following materials of construction:

| **Component** | **Material** | **Specification** |
|---|---|---|
| Disc or clapper, seat ring, valve body seat ring | Bronze or brass | ASTM B62, B16, or B584 (allows C84400 or C87600) |
| Body and cap | Cast iron | ASTM A126, Class B |
| Disc and hinge or arm | Cast iron or bronze | ASTM A126, Class B<br>ASTM B62 |
| Hinge pin | Stainless-steel | AISI Type 316 |
| Cover bolts and nuts | Stainless-steel | ASTM A193, Grade B8M;<br>ASTM A194, Grade 8M |

Ends shall be flanged, Class 125, ANSI B16.1. Valves shall be designed for a minimum working pressure of 150 psi. Valve shall be equipped with outside lever and spring. Valves shall be Clow f-5340, M&H Style 259, Crispin SWL, Milliken BBW or approved equal.

b. Silent Check Valves, Class 150: Silent check valves shall be designed to be installed between the flanges of the adjoining pipe. Valves shall be equipped with a spring mechanism to provide for nonslam closure of the valve without backflow, in any position, and shall not be dependent on gravity or backflow for closure. Materials of construction shall be as follows.

| Component | Material | Specification |
|---|---|---|
| Body | Cast iron or ductile iron | ASTM A 126, Class B; or ASTM A 536, Grade 65-45-12 |
| Plug and seat | Bronze | ASTM B 584 |
| Spring, pin, stops | Stainless-steel | AISI Type 316 |
| Sealing element | Buna-N | |

Valves shall be APCO Series 600, Crispin WC, Milliken or approved equal.

9. Solenoid Valves 1-1/2-Inches and Smaller: Solenoid valves of sizes 1/4-inch through 1-1/2-inches for water and air service shall have forged brass (Alloy C23000) or bronze (ASTM B 62) bodies with Teflon main seats. Internal plunger, core tube, plunger spring, and cage assembly shall be stainless steel (Types 302, 304, or 305). Solenoid enclosures shall be NEMA Type IV. Valve actuators shall be 24-volt AC. Seals shall be Teflon. Valves shall have a maximum operating pressure and a maximum differential pressure of 250 psi. Solenoid valves shall be normally closed and energized to open. Valves shall be ASCO "Red Hat," only.

10. Tapping Valves: Tapping valves shall conform with the requirements for resilient seat gate valves 3-inches and larger. Valve ends shall be flanged. Valves shall be Clow RW, Mueller A2360, American AVK, American Flow Control AFC500, and M&H Style 4067, or approved equal. See Standard Drawing W-6.

11. Tapping Sleeves: Tapping sleeves shall be either the "mechanical joint" type or stainless steel full-circle style sleeves. Gaskets shall be EPDM rubber with a wide cross-section. Bolts, nuts, and washers shall be Type 316 stainless steel. Mechanical joint tapping sleeves shall be JCM Industries, Inc. JCM 414, Mueller H-615 or approved equal. Stainless steel full-circle tapping sleeves shall be JCM Industries, Inc. JCM 432, Mueller H-304SS, Romac SST111 or for contracts between District and Contractor, approved equal. See Standard Drawing W-6.

12. Detector Check Valves: Detector check valves shall have flanged ends conforming to ANSI B16.1, Class 125. Valves shall be pressure tested to twice design working pressure. Valve casing shall be hot-dipped galvanized and body shall be tapped to accept by-pass meter piping. Materials of construction shall be as follows:

| Component | Material | Specification |
|---|---|---|
| Body, bonnet | Cast iron | ASTM B126, Class B |
| Bonnet bolts | Stainless-steel | ASTM A276, Type 304 |

| | | |
|---|---|---|
| Hinge pin (shaft) | Stainless-steel | ASTM A276, Type 304 or 316 |
| Clapper | Bronze | ASTM B62 |
| Clapper seat ring | Bronze (tinned) | ASTM B62 |
| Clapper seal | Rubber | |
| Weight | Lead | |

The mainline valve shall automatically open, permitting unrestricted flow, when the pressure loss through the by-pass meter is approximately 1.5 psi. Valves shall be Hersey EDC II, Grinnel, Mueller A-2133-6, or approved equal.

## PART 3 - EXECUTION

### A. Joints

1. Flanged Joints: Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Flanges shall be cleaned by wire brushing before installing flanged valves. Flange bolts and nuts shall be cleaned by wire brushing, threads shall be lubricated with oil and graphite, and nuts shall be tightened uniformly and progressively. If flanges leak under pressure testing, nuts and bolts shall be loosened or removed, the gasket shall be reseated or replaced, the bolts and nuts shall be reinstalled or re-tightened, and the joint retested. Joints shall be watertight.

2. Threaded Joints: 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.

### B. Valve Installation

1. Valves in Horizontal Piping: Unless otherwise indicated on the drawings, valves in horizontal runs of pipe having centerline elevations 4'-6", or less, above the floor, shall be installed with their operating stems vertical. Valves in horizontal runs of pipe having centerline elevations between 4'-6" and 6'-9" above the floor shall be installed with their operating stems horizontal.

2. Valves in Vertical Piping: Valves on vertical runs of pipe that are next to walls shall be installed with their stems horizontal, away from the wall. Valves on vertical runs of pipe that are not located next to walls shall be installed with their stems horizontal, oriented to facilitate valve operation.

3. Buried Valves: Buried valves shall be wrapped with two layers of 8-mil polyethylene wrap per AWWA C105.

4. Valve Supports: Valves shall be anchored in concrete as shown on Standard Drawing W-8 or on the valve detail drawings. Concrete supports are not required for valves bolted to flanged pipe or fittings.

5. Backfill: Backfill within 24-inches of valves shall be clean washed sand in accordance with the requirements of Section 02223, Trenching, Backfilling, and Compacting.

## C. Valve Boxes

Valve boxes shall be firmly supported and shall be kept centered and plumb over the operating nut of the valve. Beveled sections of pipe will not be allowed at the top of the valve extension pipe. The top cut shall be square and machine made. In new tracts, and where pavement has not been placed, the valve extension risers for "key valves" shall extend well above the ground level to permit ease of location in case of emergency shutoffs. The final valve box elevation shall be flush with the finished pavement surface, or at the level shown on Standard Drawing W-8.

## D. Tapping Sleeves

Tapping sleeves shall be installed in accordance with the manufacturer's instructions. The pipe barrel shall be thoroughly cleaned with a wire brush to provide a smooth, hard surface for the sleeve. The sleeve shall be supported independent of the pipe during the tapping operation. The sleeve shall be pressure tested in the presence of the District Representative prior to tapping. The stainless steel bolts on the tapping sleeve shall be tightened with 85 to 125 foot-pounds of torque, and retightened after tap is completed. Thrust blocks shall be provided at the tapping sleeve.

## E. Valve Leakage Testing

Valves shall be tested for leakage at the same time that the connecting pipelines are tested. See Section 15042, Hydrostatic Testing of Pressure Pipelines, for pressure testing requirements.

**END OF SECTION**

# SECTION 15112

# BACKFLOW PREVENTERS

## PART 1 - GENERAL

### A. Description

This section includes materials, installation, and testing of backflow prevention assemblies.

### B. Related Work Specified Elsewhere

1. Copper Pipe and Fittings: 15057

2. Manual Valves: 15100

3. Meters: 15150

### C. Submittals

1. Submit shop drawings in accordance with Section 01300 and the following.

2. Submit certification showing that the backflow prevention assembly is approved by the Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California, School of Engineering.

## PART 2 - MATERIALS

### A. Shut-Off Valves

1. Gate Valves: The shut-off valves shall be resilient wedge gate valves conforming to Section 15100, Manual Valves, and shall have outside stems and yokes.

2. Ball Valves: Valves two-inches and smaller shall be ball valves conforming to the requirements of Section 15100.

### B. Fireline Bypass Piping

Bypass piping shall be copper or brass conforming with Section 15057, Copper Pipe and Fittings. The bypass shall include a meter and approved double check valve assembly or single check valve for Type II double check detector assemblies.

## C. Backflow Prevention Assembly

Backflow prevention assemblies shall conform to the latest edition of AWWA C510 or C511 and the "Manual of Cross-Connection Control", Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California, School of Engineering.

## D. Bypass Meter and Backflow Prevention Assembly

The bypass meter shall conform to the requirements of Section 15150, Meters, and shall be compatible with the main backflow prevention assembly to which it is installed. The backflow prevention assembly and the bypass meter and bypass backflow prevention assembly shall all be furnished as one complete unit. All bypass meters shall be 5/8-inch or 3/4-inch with cubic feet register. See Standard Drawing W-16.

Double check detector assemblies with their corresponding bypass double check backflow prevention assembly, and the Type II models shall follow the schematic of the Standard Drawings W-16 or W-16A. The backflow shall be in the horizontal configuration, as depicted in Standard Drawings W-16 and W-16A, unless otherwise approved by the District.

## E. Riser Pipe and Fittings

1. Riser pipe and fittings for residential, commercial and irrigation backflow prevention assemblies shall be brass. Short threaded nipples and brass pipe shall conform to ASTM B 43, regular wall thickness, except that nipples and pipe of sizes 1 inch and smaller shall be extra strong. Threads shall conform to ANSI B1.20.1. Brass material shall conform to ANSI/AWWA Standard C800, latest revision, with a maximum lead content of 0.25% by average weight.

2. Riser pipe and fittings for 4-inch diameter and larger backflow prevention assemblies shall be ductile iron or steel. See Standard Drawing W-16 for details.

# PART 3 - EXECUTION

## A. Installation

Installation shall comply with the requirements of the YLWD Standard Specifications and Standard Drawings and the latest edition of the Manual of Cross-Connection Control, and with the latest plumbing codes and applicable local agency requirements.

## B. Testing

Upon installation of the backflow prevention assembly, an initial test shall be performed and the test report shall be submitted to the District. The test shall be performed by a certified tester approved by the Orange County Health Care Agency, in accordance with the California Code of Regulations Title 17 - Public Health, Division 1 - Department of Health Services, Chapter 5 - Sanitation (Environmental), Subchapter 1 - Engineering (Sanitary), Group 4 – Drinking Water Supplies, Article 2 – Protection of Water System. Annual tests of the assembly are required thereafter.

**END OF SECTION**

# SECTION 15120

# DIAPHRAGM-ACTUATED CONTROL VALVES

## PART 1 - GENERAL

### A. Description

This section includes materials and installation of hydraulically-controlled diaphragm-actuated control valves that are used as pressure reducing valves, pressure sustaining valves, solenoid control valves, booster pump control valves, and altitude valves.

### B. Related Work Specified Elsewhere

1. Painting and Coating: 09900

2. Hydrostatic Testing of Pressure Pipelines: 15042

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300 and the following.

2. Submit dimensional drawings for each size and type of valve provided.

3. Provide listing of materials of construction, with ASTM reference and grade. Show valve lining and paint primer coating with coating manufacturer and coating system number or designation.

4. Submit electrical drawings (including P&IDs), showing wire and terminal connections, for valves that are electrically controlled.

5. Submit manufacturer's recommended maximum operating pressure and minimum and maximum recommended flow.

## PART 2 - MATERIALS

### A. Valve Design

1. General: Valves shall be hydraulically actuated diaphragm type. The body shall contain a removable seat insert. A resilient rubber disc shall form a drip-tight seal with the valve seat when pressure is applied above the diaphragm.

The diaphragm assembly shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure.

2. Component Parts: The pilot control system shall include a fixed or variable orifice, and all major components of this system, except solenoid pilots, shall be manufactured by the same company that manufactures the main valve.

   Elastomers shall be Neoprene or Buna-N. The diaphragm shall not be used as a seating surface.

   The valve stem shall be center guided or top and bottom guided. The stem orientation is to be vertical. For top and bottom stem guides, bearings in the valve cover and in the valve seat shall be provided. For center guided valve stems, a bearing in the valve cover shall be provided. Stem sleeves or bearings shall have an anti-scale treatment or other approved friction reducing surface.

   A valve position indicator or limit switch assembly shall be provided.

   Repairs and modification other than the replacement of the main valve body shall be possible without removing the main valve from the line.

## B. Materials of Construction

Materials of construction for Class 125 and Class 250 valves larger than 1 inch in size shall be as follows:

| Item | Material |
|---|---|
| Main valve body and cover | Ductile iron, ASTM A 536, Grade 60-40-18 |
| Main valve trim and seat | Type 303 stainless steel, ASTM A 276, or A351 |
| Pilot control system | Cast bronze, ASTM B 62, with Type 303 stainless-steel trim |
| Piping and tubing | Type 303 Stainless Steel |
| Bonnet studs | Type 304 Stainless Steel |
| Bonnet nuts and body plugs | Type 316 Stainless Steel |

## C. Valve End Connections

1. General: Valves 2-inches and smaller shall have threaded ends. Valves larger than 2-inches shall have flanged ends.

2. Flanged Ends: Flanges for valves shall be ductile iron, meeting the requirements of ASTM A 536. Class 125 (for 150 psi) and Class 250 (for 300 psi) flanges shall conform to ANSI B16.1. Note: Class 125 flanges have a smaller bolt circle and dimensions and will not mate to a Class 250 flange.

3. Threaded Ends: Threaded ends shall comply with ANSI B1.20.1.

**D. Interior Valve Lining**

Interior surfaces of the valve shall be coated in accordance with Section 09900, Painting and Coating, System No. G-1.

**E. Coating**

Valves shall be coated the same as the adjacent piping, and in accordance with Section 09900, Painting and Coating. Prime coat shall be applied at factory. Finish coats shall be applied in the field. Paint system and color of finish coat shall match that of connecting piping.

**F. Valves**

1. Class 125 (150 psi) or Class 250 (300 psi) Pressure-Reducing Valves: Pressure reducing valves shall automatically maintain a constant downstream pressure regardless of changing flow rates and/or varying inlet pressures. The pilot control shall be direct-acting, spring loaded, diaphragm valve, designed to permit flow when controlled pressure is less than the spring setting. The pilot control system shall be provided with a strainer, isolation valves, opening speed control, closing speed control, and, where required for low flow, a flow stabilizer or V-port throttling plug. Consult District for pressure ranges and initial pressure settings. The valve shall be globe pattern Cla-Val Model 90-01 with X101 valve position indicator or approved equal.

2. Class 125 (150 psi) or Class 250 (300 psi) Pressure Sustaining or Pressure Relief Valves: Pressure sustaining/relief valves shall maintain a constant upstream pressure by relieving excess pressure without causing surges. The pilot control system shall operate such that as excess line pressure is dissipated, the valve shall slowly close. The pilot control shall be a direct acting, spring-loaded, diaphragm valve, designed to permit flow when cont rolling pressure exceeds a spring setting. The pilot control system shall be provided with a strainer, isolation valves, opening speed control (pressure sustaining valves only), and closing speed control. Consult District for pressure ranges and initial pressure settings. The valve shall be globe pattern Cla-Val Model 50-01 with X105LOW limit switch assembly or approved equal.

3. Class 125 (150 psi) or Class 250 (300 psi) Solenoid Control Valves: Solenoid control valves shall provide on or off service for controlling flow. The pilot control shall be a three-way solenoid valve as specified herein. The pilot control system shall be provided with strainers, isolation valves, opening speed control, and closing speed control. Consult District for energized-to-open or de-energized-to-open requirements. The valve shall be globe pattern Cla-Val Model 136-03 with X105LCW limit switch assembly or approved equal.

4. Class 125 (150 psi) or Class 250 (300 psi) Booster Pump Control Valve: Booster pump control valves shall be designed for installation on the discharge of booster pumps to eliminate pipeline surges caused by starting and stopping of pumps. Control of valve operation shall be by means of an externally mounted solenoid pilot valve. The solenoid pilot valve shall be as specified herein. Self-cleaning strainers shall be used to protect the control system. Valves shall utilize line pressure for operation. A limit switch shall be provided to be adjustable over entire valve travel. Valve shall be equipped with a check feature to prevent reversal of flow. The valve shall be globe pattern Cla-Val Model 60-11 with X105LCW limit switch assembly or approved equal.

5. Class 125 (150 psi) or Class 250 (300 psi) Altitude Valve: Altitude valves shall be designed to control the high water level in reservoirs. The valve shall be a non-throttling type, remaining fully open until the set-point in the reservoir is reached. Unless noted otherwise, the valve shall provide one-way flow, opening when the water level in the reservoir lowers below the set-point level, and shall be equipped with a check feature to prevent reverse flow. The pilot control shall be a three-way diaphragm valve that operates on the differential force between the height of the water in the reservoir and an adjustable spring load. The valve shall be globe pattern Cla-Val Model 210-01 with X101 valve position indicator or approved equal.

## G. Bolts, Nuts and Washers for Flanged Valves

1. General: Bolts and nuts for all flanges shall be Type 316 stainless steel conforming to ASTM A 193, Grade B8M for bolts and ASTM A 194, Grade 8M for nuts.

2. Washers: Type 316 stainless steel washer shall be provided for each nut.

3. Bolt Projection: The length of each bolt or stud shall be such that between 1/4 inch and 1/2 inch will project through the nut when drawn tight.

## H. Gaskets

1. Gaskets for Flanged Joints: Gaskets for flanged joints shall be 1/8 inch thick, cloth-inserted rubber. Gaskets shall be suitable for a water pressure of 350 psi at a temperature of 180ºF.

2. Full Face Type Gaskets or Ring Gaskets for Flanged Joints: Full face type gaskets with pre-punched holes shall be used where both flanges are flat face. Ring gaskets extending to the inner edge of the bolts may be used where a raised face flange is present.

3. Manufacturers: Gaskets shall be John Crane Company Style 777, John Manville No. 109, or for contracts between District and Contractor, approved equal.

# PART 3 - EXECUTION

## A. Valve Installation

1. Flanged Connections: Boltholes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Flanges shall be cleaned by wire brushing before installing flanged valves. Flange bolts and nuts shall be leaned by wire brushing, threads lubricated with anti-seize compound, and nuts tightened uniformly and progressively. If flanges leak under pressure testing, the nuts and bolts shall be loosened or removed, the gasket reseated or replaced, bolts and nuts reinstalled or retightened and the joints retested. Joints shall be watertight.

2. Threaded Connections: 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.

## B. Valve Pressure Testing

Valves shall be tested at the same time that the connecting pipelines are pressure tested. See Section 15042, Hydrostatic Testing of Pressure Pipelines, for pressure testing requirements. Valves, operators, or control and instrumentation systems whose pressure rating is less than the test pressure shall be protected or isolated during pressure testing.

**END OF SECTION**

# SECTION 15139

# FIRE HYDRANTS

## PART 1 - GENERAL

### A. Description

This section includes materials, installation, and testing of wet-barrel type fire hydrants.

### B. Related Work Specified Elsewhere

1. Trenching, Backfilling, and Compacting: 02223
2. Concrete: 03300
3. Painting and Coating: 09900
4. Hydrostatic Testing of Pressure Pipelines: 15042
5. Ductile Iron Pipe and Fittings: 15056
6. PVC Pressure Distribution Pipe and Fittings: 15064
7. Manual Valves: 15100

### C. Submittals

Submit shop drawings in accordance with Section 01300.

## PART 2 - MATERIALS

### A. Hydrant Top Section

1. General: Fire hydrants shall be of the wet-barrel type, with individual valves for each outlet, and shall conform with the requirements of AWWA C503.
2. Outlets: Single-family residential hydrants shall have one 2½-inch outlet and one 4-inch outlet. Multi-family residential and commercial hydrants shall have two 2½-inch outlets and one 4-inch outlet. All outlets shall have National Standard Hose Threads.

3. Materials of Construction: The hydrant top section shall be manufactured of a ductile iron or cast iron body, and shall be epoxy lined. All interior working parts, including stems, shall be of bronze containing no more than 7% zinc or 2% aluminum.

4. Operating Nuts: Hydrants are to be provided with 1-1/2-inch sized pentagon-shaped operating nut.

5. Operating Nut Protector Caps: 1-1/2 inch cast iron protector caps shall be provided for operating nuts.

6. Outlet Caps: Cast Iron outlet nozzle caps shall be provided for all outlets. Caps shall be securely chained to the barrel with non-kinking metal chain in a manner to permit free rotation of the cap.

7. Flanges: Hydrant flanges shall be drilled with a 6-hole pattern. The flange shall be drilled with 3/4-inch diameter holes located on a 9-3/8-inch bolt circle.

8. Manufacturer Identification: All fire hydrants shall have the name of the manufacturer cast or welded onto the fire hydrant body.

## B. Bury Section

1. Materials: The bury section shall be ductile iron and shall be cement lined in conformance with Section 15056, Ductile Iron Pipe and Fittings.

2. Inlet Connection: Inlet size is to be a 6-inch mechanical joint, unless otherwise specified on the plans.

3. Bury Depth: Bury depth will normally be 48-inches for distribution mains and 54-inches for transmission mains. Field conditions may require different fire hydrant bury depth to fit abnormal pipe depth.

4. Flanges: Hydrant flanges shall be drilled with 3/4-inch diameter holes in a 6-hole pattern on a 9-3/8-inch bolt circle.

5. Approved Manufacturers: Bury and extension sections shall be as manufactured by Clow, South Bay Foundry, or for contracts between District and Contractor, approved equal.

## C. Break-Off Check Valve

1. Break-off check valve shall be a ductile iron body with a brass flapper and stainless steel break off bar and spring. The break-off check valve shall be installed per manufacturer's recommendations.

2. Approved Manufacturers: Break-off check valve shall be Clow LBI 400A, Clow LP 619 (for hydrant retrofits only), or approved equal.

## D. Break-Off Riser

1. Materials: Break-off riser shall be a cast iron or ductile iron flanged spool, 6-inches in length, with double machined 3/16-inch to 1/4-inch deep grooves. Nuts and bolts shall be 5/8-inch, Type 316 stainless steel, and installed with the threads pointed down.

2. Flanges: Break-off risers shall be drilled with 3/4-inch diameter holes in a 6-hole pattern on a 9-3/8-inch bolt circle.

## E. Shut-Off Valve

The shut-off valve shall be a gate or resilient-seated gate valve per Section 15100, Manual Valves.

## F. Gaskets

Gaskets shall be full face, and of rubber composition, 1/8-inch thick. Full face type gaskets with pre-punched holes shall be used where both flanges are flat face. Ring gaskets extending to the inner edge of the bolts may be used where a raised face flange is present.

## G. Manufacturers

1. Low Density Residential Use: For low density residential applications, fire hydrants shall be Clow Model 850, Jones 4040 or approved equal.

2. High Density Residential and Commercial Use: For high density residential (i.e., condominium tract), commercial and industrial applications, fire hydrants shall be Clow Model 860, Jones 4060 or approved equal.

# PART 3 - EXECUTION

## A. General

1. Fire hydrant assemblies shall be installed in accordance with Standard Drawing W-21, detail drawings, and as specified herein, and shall include the connection to the main, the fire hydrant, hydrant bury, break-off check valve and riser, shutoff valve, valve well and valve box, connection piping, concrete thrust blocks, and appurtenances.

2 All fire hydrants shall be set with the top of the top flange of the break-off riser 3 inches above the concrete pad or sidewalk. See Standard Drawing W-21.

**B. Location**

Fire hydrant assemblies shall be located as shown on Standard Drawing W-21, detail drawings, or as approved by the District Representative. Spools less than 6-inches in length will not be permitted when correcting the flange elevation.

**C. Valve and Valve Box**

The valve and valve box shall be installed in accordance with Section 15100.

**D. Concrete**

The concrete pad and thrust blocks shall be Class C concrete placed per Section 03300.

**E. Painting**

All above ground portions of the fire hydrant and bury shall be painted with one prime coat and two finish coats of paint in the field, in accordance with Section 09900, Painting and Coating after the fire hydrant has been installed. The second finish coat shall be applied just prior to the final inspection.

**F. Testing**

Hydrants shall be tested at the same time that the connecting pipeline is pressure tested. See Section 15042, Hydrostatic Testing of Pressure Pipelines, for pressure testing requirements.

**END OF SECTION**

# SECTION 15150

# METERS

## PART 1 - GENERAL

### A. Description

This section describes the materials, installation, and testing of meter assemblies.

### B. Related Work Specified Elsewhere

1. Structural Earthwork: 02200
2. Concrete: 03300
3. Precast Concrete Vaults: 03462
4. Painting and Coating: 09900
5. Ductile-Iron Pipe and Fittings: 15056
6. Copper Pipe and Fittings: 15057
7. Manual Valves: 15100

### C. Submittals

Shop drawings shall be submitted in accordance with Section 01300.

## PART 2 - MATERIALS

### A. General

All meters shall be furnished and installed by the District, unless specified.

### B. Stainless Steel Hardware

All bolts, nuts, capscrews, studs, and washers shall be Type 316 stainless steel.

## C. Displacement Type Meters (1-Inch Through 2-Inch)

1. General: Meters shall conform to the material and performance requirements of AWWA C700 and as specified herein.

2. End Connections: 1-inch meters shall have external straight threads. 1½-inch and 2-inch meters shall have flanges on ends.

3. Dimensions: The face to face length of the meter shall be as follows:

| Meter Size (inches) | Face-to-Face Dimension (inches) |
|---|---|
| 1 | 10¾ |
| 1½ | 13 |
| 2 | 17 |

## D. Turbine Meters (2-Inch and Larger)

1. General: Meters shall conform with AWWA C701 Class II and the requirements specified herein.

2. End Connections: All turbine meters shall have flanged connections, with Type 316 stainless steel bolts, nuts, and washers.

## E. Manual Valves

Valves shall conform to Section 15100, Manual Valves. Valves on by-pass shall be lockable in the closed position.

# PART 3 - EXECUTION

## A. Meter Installations

1. Residential Meters: Residential meters shall be installed as shown on the plans, or per Standard Drawing W-1 or W-2.

2. 3-Inch and Larger Meters: 3-inch and larger meters shall be installed as shown on the plans or per Standard Drawing W-4 or W-5.

3. Contractor shall obtain perforated spacer pipe and gaskets from the District and install per Standard Drawing, unless specified. District shall remove spacer and install meter.

## B. Service Piping

All piping for service lines and by-pass lines shall be installed in conformance with Section 15057, Copper Pipe and Fittings, and Section 15051, Installation of Pressure Pipelines.

## C. Testing

Meter services shall be hydrostatically pressure tested during the testing of pipeline in accordance with Section 15042, Hydrostatic Testing of Pressure Pipelines. Meters 3-inches and larger will be tested by the District to verify accuracy prior to being put into service.

**END OF SECTION**

# SECTION 15151

# WATER AND SEWER FACILITIES IDENTIFICATION

## PART 1 - GENERAL

### A. Description

This section describes materials and installation of water and sewer facilities identification for pipe, valves, valve boxes, and other pipeline appurtenances.

### B. Related Work Specified Elsewhere

1. Painting and Coating: 09900

2. Installation of Pressure Pipelines: 15051

3. Manual Valves: 15100

### C. Submittals

1. Submit shop drawings in accordance with Section 01300 including the following:

2. Submit material samples of warning tape.

3. Submit drawings showing location and size of warning labels and signs.

## PART 2 - MATERIALS

### A. Buried Piping Detectable Warning Tape

Detectable warning tape shall be used on all water and sewer pipelines. The tape shall be an inert plastic film specifically formulated for prolonged underground use and shall include a metallic substance that can be registered by a magnetic field location device. The minimum thickness shall be 4 mils and the overall width of the tape shall be 3-inches. The lettering shall have a minimum height of 2-inches.

Detectable warning tape shall be Reef Industries, Inc. Terra Tape®, Christy's™ or approved equal.

1. Water Pipelines: Detectable warning tape shall be in blue color, and have the following message printed at minimum 36-inch intervals: "CAUTION: WATER LINE BURIED BELOW."

2. Sewer Pipelines: Detectable warning tape shall be in green color, and have the following custom message printed at minimum 36-inch intervals: "CAUTION: SEWER LINE BURIED BELOW."

## B. Tracer Wire

Tracer wire shall be #10 A.W.G. multi-stranded copper wire with high molecular weight polyethylene insulation suitable for direct burial.

## C. Warning Labels and Tags

Labels shall be inert plastic film specifically formulated for prolonged exposure. The minimum thickness shall be 4 mils for adhesive backed labels and 10 mils for tag type labels. Tag type labels shall have reinforced tie holes and shall be attached with heavy-duty nylon fasteners. The size, type of label and location shall be dictated by each individual application and subject to acceptance by the District's Representative.

1. Water Identification: Labels shall be prepared on a blue field, and shall have the words: "YLWD WATER" printed on the field in black letters. Minimum letter height shall be 1/2-inch.

2. Meter Identification Tags: Round brass tags shall be fastened to each water service meter to identify the address and/or unit number served by the meter. Tags shall be 1-inch diameter and thickness of 18 gauge. It shall be fastened to the copper pipe immediately below the angle meter stop with a polyethylene zip tie. The address and/or unit number shall be stamped into the brass tag with metal die stamps with letters ⅜-inch in height.

## D. Utility Markers

Utility markers shall be fiberglass-composite marking posts manufactured for long term outdoor durability and impact and vandal resistance. The marker shall be 66-inches in length and have a minimum width of 3.75 inches. The marker shall contain a 3.25" x 2.75" custom decal of the YLWD logo and a facility label with 1-inch high lettering on both sides of the post. See Standard Drawing G-1 for details.

Color shall be determined by the District Representative. Generally, utility markers within developed areas shall be white with black lettering. In undeveloped areas, the color shall correspond to the utility type with white lettering: blue for water, green for sewer, and red for cathodic protection test stations.

Utility markers shall be Carsonite® Composites CIB-380, Christy's™ Superflex™, or approved equal.

## PART 3 - EXECUTION

### A. Installation of Pipe Detectable Warning Tape and Tracer Wire

1. Detectable Warning Tape: Detectable warning tape shall be installed 12" above the top of the pipe longitudinally, and shall be centered over all pipelines. The tape shall be installed continuously for the entire length of the pipe.

2. Tracer Wire: Tracer wire shall run continuously along the top of pipe for the entire length of pipe. The wire shall be secured to the pipe at 10-foot intervals with plastic adhesive tape, duct tape or plastic tie straps. Tracer wire may terminate within meter boxes, blow-off boxes, fire hydrants, or combination air vacuum–air release valve assembly enclosures as directed by the District Representative at intervals of not more than 1000-feet. Sufficient slack shall be left in leads near connections to pipe to prevent breakage of connection during backfilling.

   After all trench backfill operations are complete, the Contractor shall pay for a third-party tester to conduct the locatability test and confirm that the wire is continuous. The Contractor shall be responsible for all costs to confirm, locate, and repair any breaks in the wire identified in the locatability test. After the repair, the third-party tester shall retest the wire for continuity. The Contractor is advised to use care in the installation and backfilling operations to prevent damage to the wire.

### B. Installation of Warning Labels and Signs

1. Method of Attachment: Warning labels shall be firmly attached using heavy-duty nylon fasteners, and shall be sized and installed at locations as shown on the plans.

2. Equipment Requiring Labels or Tags: Warning labels shall be installed on all appurtenances in vaults, such as, but not limited to, air release valves, blowoffs, and meters, and on designated facilities, such as, but not limited to, controller panels and washdown or blowoff hydrants on water trucks and temporary construction services. Pumps and pipe shall be identified with a painted label. Within a fenced area, at least one sign shall be posted on the fence which can be readily seen.

3. Painted Labels: Painted labels may, at the District Representative's discretion, be acceptable in lieu of plastic labels.

## C. Installation of Utility Markers

Utility markers shall be buried to a minimum depth of 18-inches with a vandal-resistant anchor kit. The marker shall be installed at a minimum distance of 3 feet from the edge of the water or sewer facility. The marker shall be labeled with the offset distance and direction from the facility on one side.

**END OF SECTION**

# SECTION 15162

# FLEXIBLE PIPE COUPLINGS AND EXPANSION JOINTS

## PART 1 - GENERAL

### A. Description

This section describes materials and installation of flexible gasket sleeve-type compression pipe couplings for steel, asbestos-cement pipe and ductile iron pipe.

### B. Related Work Specified Elsewhere

1. Painting and Coating: 09900

2. Hydrostatic Testing of Pressure Pipelines: 15042

3. Cathodic Protection and Joint Bonding: 16640

### C. Submittals

1. Shop drawings shall be in accordance with Section 01300 and the following.

2. Submit manufacturer's catalog data on flexible pipe couplings. Show manufacturer's model or figure number for each type of coupling or joint for each type of pipe material for which couplings are used.

3. Submit manufacturer's recommended torques to which the coupling bolts shall be tightened for the flexible gasket sleeve-type compression pipe couplings.

4. Show materials of construction by ASTM reference and grade. Show dimensions.

5. Show number, size, and material of construction of the rods and lugs for each thrust harness on the project.

## PART 2 - MATERIALS

### A. Flexible Pipe Couplings for Steel Pipe

1. General: Steel couplings shall be long-style center sleeves made of steel conforming to ASTM A 36, A 53 (Type E or S), or A 512 having a minimum yield strength of 30,000 psi. Follower rings shall be malleable iron (ASTM A 47, Grade 32510), ductile iron (ASTM A 536), or steel (ASTM A 108, Grade

1018, or ASTM A 510, Grades 1018 or 1021). Follower ring material shall match that of the pipe being joined (i.e., steel follower rings on steel pipe; malleable iron rings for ductile iron pipe). Minimum center sleeve length shall be 5 inches for pipe diameters of 3/4-inch through 3-inch; 7 inches for pipe diameters of 4-inch; and 12 inches for pipe diameters 6-inch and greater.

2. Sleeve Bolts: Sleeve bolts shall have a minimum yield strength of 40,000 psi, an ultimate strength of 60,000 psi, shall be fabricated of Type 316 stainless steel conforming to ASTM A 193 (Grade B8M) for bolts and ASTM A 194 (Grade B8M) for nuts, and shall conform to AWWA C111.

3. Manufacturers: Flexible pipe couplings for steel pipe shall be steel and shall be Baker Series 208, Ford Style FC3 and FC4, Romac Style 400, or approved equal.

**B. Joint Harness**

1. Tie Bolts or Studs: Tie bolts or studs shall be as shown in AWWA Manual M11, Table 13-6, 13-7, and 13-7A. The minimum numbers and sizes of tie bolts or studs shall be as shown in the table below. Bolt or stud material shall conform to ASTM B 193, Grade B8, Type 316 stainless steel. Nuts shall conform to ASTM A 194, Grade B8M, Type 316 stainless steel. Lug material shall conform to ASTM A 36, ASTM A 283, Grade B, C, or D, or ASTM A 285, Grade C. Lug dimensions, plate thickness, and weld dimensions shall be as shown in AWWA Manual M11, Figure 13-17, Type 316 stainless steel.

**TIE BOLTS OR STUD REQUIREMENTS FOR FLEXIBLE PIPE COUPLINGS**

| Tie Bolt or Stud Minimum Requirements | | | | |
|---|---|---|---|---|
| Nominal Pipe Size (inches) | 150 psi | | 250 psi | |
| | No. Bolts or Studs | Size (inches) | No. Bolts or Studs | Size (inches) |
| 2 | 2 | 5/8 | 2 | 5/8 |
| 3 | 2 | 5/8 | 2 | 5/8 |
| 4 | 2 | 5/8 | 2 | 5/8 |
| 6 | 2 | 5/8 | 2 | 5/8 |
| 8 | 2 | 5/8 | 2 | 5/8 |
| 10 | 2 | 5/8 | 2 | 3/4 |
| 12 | 2 | 3/4 | 2 | 7/8 |
| 14 | 2 | 3/4 | 2 | 1 |
| 16 | 2 | 7/8 | 2 | 1-1/8 |
| 18 | 2 | 1 | 2 | 1-1/4 |
| 20 | 2 | 1 | 2 | 1-1/4 |
| 24 | 4 | 7/8 | 4 | 1-1/8 |
| 30 | 4 | 1-1/8 | 4 | 1-3/8 |

| Tie Bolt or Stud Minimum Requirements | | | | |
|---|---|---|---|---|
| Nominal Pipe Size (inches) | 150 psi | | 250 psi | |
| | No. Bolts or Studs | Size (inches) | No. Bolts or Studs | Size (inches) |
| 36 | 4 | 1-1/4 | 4 | 1-5/8 |
| 42 | 4 | 1-1/2 | 6 | 1-1/2 |
| 48 | 6 | 1-5/8 | 6 | 1-3/4 |
| 54 | 6 | 1-1/2 | 8 | 1-3/4 |
| 60 | 6 | 1-5/8 | 10 | 1-5/8 |
| 66 | 8 | 1-5/8 | 12 | 1-3/4 |
| 72 | 8 | 1-3/4 | 12 | 1-7/8 |
| 84 | 10 | 1-3/4 | 14 | 2 |
| 96 | 12 | 1-7/8 | 16 | 2-1/4 |

2. Criteria for Number and Size of Tie Bolts or Studs: The number and size of bolts shall be selected based on the test pressure shown in Section 15042, Hydrostatic Testing of Pressure Pipelines. For test pressures less than or for contracts between District and Contractor, approved equal to 150 psi, the 150-psi design in the table above shall be used. For test pressures between 150 and 250 psi, the 250-psi design in the table above shall be used.

3. Washers: Stainless steel, Type 316 washers shall be provided for each lug. Washer material shall be the same as the nuts. Minimum washer thickness shall be 1/8-inch.

4. Wall Thickness Requirement for Welded Lugs: Pipe wall to which lugs are welded shall be adequate to resist stresses. If necessary, the pipe wall thickness shall be increased.

## C. Flexible Pipe Couplings for Asbestos-Cement Pipe

1. General: Flexible pipe couplings for asbestos-cement pipe shall be ductile iron with long-style center sleeves a minimum of 12 inches in length for all pipe diameters and shall have corrosion resistant Type 316 stainless steel nuts, bolts, and washers. Center sleeve and follower rings shall be epoxy coated and holiday free.

2. Sleeve Bolts: Sleeve bolts shall be corrosion resistant Type 316 stainless steel with a minimum yield strength of 45,000 psi and shall conform to ASTM A 193 and AWWA C111.

3. Manufacturers: Ductile iron flexible pipe couplings for asbestos-cement pipe shall be Smith-Blair Type 442 and 462, Ford Style FC2A-L12, Romac Style 501 and XR501, or approved equal.

## D. Flexible Couplings for Ductile Iron Pipe

1. General: Ductile iron pipe couplings shall have sleeves of ASTM A 126 Class B ductile iron with a minimum yield strength of 30,000 psi. Follower rings shall be malleable iron ASTM A 47 Grade 32510 or ductile iron ASTM A 536. Minimum center sleeve length shall be 10 inches for pipe diameters up to 6-inch and shall be 12 inches for pipe diameters greater than 6-inch.

2. Sleeve Bolts: Sleeve bolts shall be corrosion resistant Type 316 stainless steel with minimum yield strength of 45,000 psi and shall conform to ASTM A 193 and AWWA C111.

3. Manufacturers: Flexible couplings for ductile iron pipe shall be ductile iron: Smith-Blair Type 442, Ford Style FC1-L12, Romac Style 501, or approved equal.

## E. Transition Couplings

1. Steel Pipe and Concrete Cylinder Pipe: Transition couplings for connecting steel pipe and concrete cylinder pipe having different outside diameters shall be steel: Smith-Blair Type 413, Baker Series 212 or 240, or approved equal. Minimum center sleeve length shall be 12 inches for all pipe diameters.

2. Steel Pipe and Ductile Iron Pipe: Transition couplings for connecting steel pipe and ductile iron pipe shall be Romac Style IC501 or approved equal.

3. Ductile Iron Pipe, PVC Pipe, and Asbestos Cement Pipe: Transition couplings for connecting ductile iron pipe, PVC pipe, and asbestos cement pipe having different outside diameters shall be ductile iron, and shall be Smith-Blair Type 442 and 462, Ford Style FC2A-L12 and FC2W-L12, Romac Style 501 and XR501, or approved equal. For thin wall PVC pipe, such as C909, consult with the manufacturer's engineer for the installation of pipe stiffeners, Type 316 stainless steel. Minimum center sleeve length shall be 12 inches for all pipe diameters.

4. Sleeve Bolts: Sleeve bolts shall have a minimum yield strength of 40,000 psi, an ultimate strength of 60,000 psi, shall be Type 316 stainless steel conforming to ASTM A 193 (Grade B8M) for bolts and ASTM A 194 (Grade B8M) for nuts, and shall conform to AWWA C111.

## F. Reducing Couplings

Reducing couplings for steel pipe shall be steel. Reducing couplings for ductile iron pipe, PVC pipe, and asbestos cement pipe shall be ductile iron. Couplings shall be Smith-Blair Type R441, Romac Style RC501, or approved equal.

## G. Flanged Coupling Adapters

Where detailed on the approved plans, flanged coupling adapters may be used to install valves, meters, and other types of flanged fittings to plain end pipe of diameter 10-inches and smaller. Flanged coupling adapters shall be Smith-Blair Type 912, Ford Style FFCA and FCA, Romac Style FCA501, RFCA or Alpha FC, or approved equal.

## H. Expansion Joints

1. General: Expansion joints shall have body, flanges, and slip pipe of carbon steel. Packing shall consist of a minimum of four rubber rings, each separated by jute packing. For installation in steel pipelines, expansion joint shall have plain ends, beveled for welding. For installation in ductile iron pipelines, expansion joint shall have plain ends. Slip pipe shall have a machined surface, and body shall be equipped with pipe stops. Where called for on the plans, limit or stop rings and limit rods shall be provided to prevent the slip pipe from pulling out of the joint.

2. Limit Rods and Body Studs, Bolts and Nuts: Limit rods and body studs, bolts, and nuts shall be Type 316 stainless steel conforming to ASTM A 193 (Grade B8M) for rods and bolts, and ASTM A 194 (Grade B8M) for nuts.

3. Manufacturers: Expansion joints shall be Baker Series 403 or 404, Smith-Blair Type 611 or 612, or approved equal.

## I. Sleeve Bolts and Nuts for Flanges

1. Stainless Steel Bolts: Bolts and nuts for buried and submerged flanges, flanges in underground vaults and structures, and flanges located outdoors above ground shall be Type 316 stainless steel conforming to ASTM A 193 (Grade B8M) for bolts and ASTM A 194 (Grade B8M) for nuts.

2. Washers: (Type 316 stainless steel) Washers shall be provided for each nut. Washers shall be of the same material as the nuts.

# PART 3 - EXECUTION

## A. Installation of Flexible Pipe Couplings and Expansion Joints

1. General: Oil, scale, rust, and dirt shall be cleaned from pipe ends. Gaskets in flexible pipe couplings shall be cleaned before installing. Expansion joints shall be installed per manufacturer's recommendations. Expansion joints shall be installed so that 50% of total travel is available for expansion and 50% is available for contraction.

2. Bolt Thread Lubrication: Bolt threads shall be lubricated with anti-seize compound prior to installation.

## B. Painting and Coating

1. Flexible Couplings: Flexible pipe couplings (including joint harness assemblies), transition couplings, flanged coupling adapters, and expansion joints shall be coated per Section 09900, Painting and Coating; sleeves shall be coated per System G-1. After installation couplings shall be wrapped with 8-mil polyethylene wrap per AWWA C105.

2. Interior Surface Coating: Interior surfaces of flexible coupling and transition coupling sleeves, and the body of expansion joints shall be coated per Section 09900, Painting and Coating, System G-1.

## C. Bonding Flexible Pipe Couplings

Buried flexible pipe couplings that are connected to ductile-iron, cast-iron, or steel pipe shall be bonded to adjacent piping as described in Section 16640, Cathodic Protection and Joint Bonding.

## D. Hydrostatic Testing

Flexible pipe couplings, expansion joints, and expansion joints shall be hydrostatically tested in place with the pipe being tested. Test shall be performed in accordance with Section 15042, Hydrostatic Testing of Pressure Pipelines.

**END OF SECTION**

# SECTION 16640

# CATHODIC PROTECTION AND JOINT BONDING

## PART 1 - GENERAL

### A. Description

This section describes materials and installation of cathodic protection and testing equipment including wiring, zinc anodes, joint bonding, test stations, reference cells, alumino-thermic welds, and flange insulation kits.

As directed by the District, the Engineer or Contractor shall conduct soils testing to determine the level of cathodic protection required for each project. Corrosive soil conditions shall require the Engineer to retain the services of a registered Corrosion Engineer to design the cathodic protection system. The Corrosion Engineer may incorporate this specification section and standard drawings in the design. Anode specification and the use of terminal boards shall be designed by the Corrosion Engineer.

### B. Related Work Specified Elsewhere

1. Trenching, Backfilling, and Compacting: 02223

2. Painting and Coating: 09900

### C. Submittals

1. Shop drawings shall be submitted in accordance with Section 01300 and the following.

2. Submit manufacturer's catalog data on wire and cables, test stations, reference cells, thermic welds, insulation kits, dielectric coatings, and anodes.

## PART 2 - MATERIALS

### A. Alumino-Thermic Weld Materials

Cartridges and sleeves for welding test lead wires, joint bonding wires and anode lead wires to the pipe, shall be "Cadweld," "Thermoweld," or for contracts between District and Contractor, approved equal. Cartridge type, size and weight shall be as recommended by the manufacturer for the type of pipe (steel, ductile iron, or cast iron) to which the wire is to be welded, size of wire, and welder mold being used.

## B. Alumino-Thermic Weld Caps

Alumino-thermic weld caps shall be high-density polyethylene plastic, 10 mils (minimum) thick, as manufactured by Royston Laboratories, Phillips Petroleum, or for contracts between District and Contractor, approved equal. Design shall incorporate an elastomeric or a mastic-filled dome and a tunnel portion to contain lead wire from the alumino-thermic weld connection. The mastic coating shall be Koppers Bitumastic 50, Tnemec 46-450, Gilsonite, or approved equal. Prior to application of the mastic coating, the manufacturer's recommended primer shall be applied to exposed metal.

## C. Test Stations

1. At-Grade Two Wire, Four Wire, Insulator and Casing Test Boxes: At-grade two wire, four wire, insulator, and casing test boxes shall be 8-3/4-inch diameter, 12-inch deep, precast concrete box with a cast iron lid designed for H-20 traffic loading. Cast on the lid shall be the words "YLWD C.P. TEST". Test box shall be Eisel Enterprises Inc. W20VB and W20VC, Brooks Products 1RT, Christy F08, or approved equal. See Standard Drawing CP-4 for details.

2. Alternative At-Grade Four Wire, Insulator and Casing Test Boxes: As an alternative, at-grade four wire, insulator and casing test boxes may be precast concrete meter boxes 19-1/8-inches by 13-1/4-inches, 19-1/8-inches by 13-1/4-inches with a cast iron lids designed for traffic loading. Cast on the lid shall be the words "C.P. TEST". See the plans or Standard Drawing CP-5 for details.

## D. Pipe Leads

Unless noted otherwise, pipe leads shall be stranded copper wire with high molecular weight polyethylene (HMW/PE) insulation specifically designed for cathodic protection service and suitable for direct burial in corrosive soil or water. Wire gauge shall be as shown on Standard Drawing CP-1, CP-2, and CP-3. Polyethylene insulation shall conform to ASTM D 1248, Type 3, Class C, Grade 5. Each pipe lead shall be of sufficient length to extend from the attachment to the pipe to the test box or anode test box without a splice. Wires with cut or damaged insulation will not be accepted. Insulation color shall be as shown on the plans or Standard Drawings.

## E. Joint Bonding Wires

Pipe joint bonding wires shall be AWG No. 8 stranded copper wire with 7/64-inch thick high molecular weight polyethylene (HMW/PE) insulation rated for 600 volts. The number of conductors shall be as shown on the plans. Polyethylene insulation shall conform to ASTM D1248, Type 3, Class C, Grade 5. Each bond wire shall not exceed 18-inches in length.

## F. Flange Insulation Kits

Insulating material shall be of the type designated by the manufacturer as suitable for the operating temperature and pressure of the service. Flange insulation kits shall consist of:

1. Insulating Gaskets: Gaskets shall be Type E fullfaced, 1/8-inch-minimum thickness, dielectric neoprene faced phenolic.

2. Insulating Sleeves and Washers: Insulating stud sleeves and washers shall be one-piece and full-length, made of Minlon. One 1/8-inch thick gasket will be attached to the sleeve, while the other one will be loose. Single insulating washers and sleeves shall be used on buried insulating flanges. Double insulating washers and sleeves shall be used on insulating flanges above ground or in vaults.

3. Insulating Washers for Bolts: Insulating washers shall be 1/8-inch-thick phenolic. Single insulating washers shall be used on buried insulating flanges. Double insulating washers and full length sleeves shall be used on insulating flanges above ground or in vaults.

4. Steel Washers Over Insulating Washer: Steel washers shall be 1/8-inch thick Type 316 stainless steel.

5. Compatibility with Tapping Valves: If the insulating flange kit is not compatible with the tapping valve, an additional flanged spool or a prefabricated insulating joint will be required.

6. Manufacturers: Flange Insulation Kit Products shall be as manufactured by PSI Industries, Central Plastics Company, APS (Advanced Product & Systems) or approved equal.

## G. Buried Insulating Flange External Coating

1. Primer: Primer shall be a blend of petrolatums, plasticizers and corrosion inhibitor having a paste-like consistency. The material shall have the following properties:

| | |
|---|---|
| Pour Point | 90-100°F |
| Flash Point | 350°F min |
| Coverage (approx.) | 1 gal/100 sq. ft. |
| Color | Brown |

The primer shall be Trenton Wax-Tape Primer, or approved equal.

2. Wax-Tape: Flange covering material shall be a plastic-fiber felt tape, saturated with a blend of petrolatums, plasticizers and corrosion inhibitors that is easily formable over irregular surfaces. The tape shall have the following properties:

| | |
|---|---|
| Tape Width | 6-inches |
| Saturant Pour Point | 115-120°F |
| Thickness | 50-70 mils |
| Dielectric Strength | 100 Volts/Mil |
| Color | Brown |

The Wax-Tape shall be Trenton #1 Wax-Tape, or approved equal.

3. Outer Covering: The primed and wax-tape wrapped flange shall be covered with a plastic wrapper consisting of three (3) each of 50 gauge, clear, polyvinylidene chloride, high cling membranes wound together as a single sheet. The material shall have the following properties:

| | |
|---|---|
| Width | 6-inches |
| Thickness | 1.5 mils |
| Dielectric Strength | 2000 Volts/Mil |
| Water Absorption | negligible |
| Color | Clear |

The outer covering shall be Trenton Poly-Ply, or approved equal.

## H. Above Ground Insulating Flange External Coating

Above ground insulating flange coating shall consist of self fusing elastic putty tape and vinyl plastic electrical tape. The self fusing elastic putty tape shall be Scotchfil Electrical Insulation Putty or District-approved equal. The vinyl plastic electrical tape shall be Scotch #33 +, or approved equal.

## I. Internal Insulating Flange Coating

Coating for the interior lining of the pipeline at the insulating flange shall be a two-part smooth white, thixotropic liquid epoxy consisting of 100 percent solids. Coating shall be Aquatapoxy Paint as manufactured by American Chemical Corporation, or approved equal.

## J. Zinc Anodes

1. Zinc Anode: Anode shall conform to ASTM B 418, latest revision, Type II and shall be a prepackaged zinc alloy ingot having a chemical composition not exceeding the following limits:

| | |
|---|---|
| Lead | 0.003% Max. |
| Aluminum | 0.005% Max. |

| | |
|---|---|
| Cadmium | 0.003% Max. |
| Iron | 0.0014% Max. |
| Copper | 0.002% Max. |
| Zinc | Remainder |

2. Anode Backfill: Each zinc anode shall be prepackaged in a permeable cloth bag with a backfill of the following composition or installed bare and backfilled with material having the following composition:

| | |
|---|---|
| Gypsum | 75% |
| Powdered Bentonite | 20% |
| Anhydrous Sodium Sulfate | 5% |

Backfill grains shall be capable of 100% passing through a 20 mesh screen and 50% passing through a 100 mesh screen. The backfill shall be firmly packed around the anode by mechanical vibration to density, which will maintain the zinc ingot in the center of the cloth bag and surrounded by at least 1-inch of backfill. The packaged weight of the zinc anode and backfill shall be approximately twice the weight of the zinc anode ingot weight.

3. Steel Core: Anode shall be cast full length with an electrogalvanized 1/4-inch diameter steel core which shall be exposed at one end for connection of the anode lead wire.
4. Anode Lead Wire: Anode lead wire shall be AWG No. 8 stranded copper wire with high-molecular weight polyethylene (HWW-PE) insulation suitable for direct burial use. HMW-PE insulation shall conform to ASTM D1248, Type 1, Class "C", Category 5, Grades E4 and E5 with tensile strength J1, J3.

Wire shall be attached to the steel core with silver solder by the manufacturer. The connection shall be encapsulated in a heat-shrinkable sleeve. Anode lead wire shall be of sufficient length of extend from the anode to the designated termination point without a splice. Wires with cut or damaged insulation will not be accepted and replacement of the entire lead will be required at the Contractor's expense.

## K. Brass Identification Tags

Identification tags with die stamped identifying letters and numbers, shall be 18 gauge brass and 1½-inch in diameter. There shall be a small hole in the tag for attachment to the wires in the various test boxes. See Standard Drawing CP-6 for details.

## L. Buried Cathodic Protection Cable Detectable Warning Tape

Detectable warning tape shall be 3-inches wide, in red color. The tape shall be inductively locatable and conductively traceable using a standard pipe and cable locating device. The tape shall be composed of one layer of aluminum foil laminated

between two layers of inert plastic film resulting in a minimum thickness of 4.5 mils. The tape shall have the following custom message printed at minimum 36-inch intervals: "CAUTION: CATHODIC PROTECTION CABLE BURIED BELOW." The tape shall have a minimum tensile strength of 60 pounds per 3-inch wide strip. The tape shall be inert and not degrade when exposed to alkalis, acids, and other destructive elements commonly found in soil. The ink used to print the message on the tape shall be permanent and not be removable by normal handling or upon prolonged underground burial. The tape shall be "Terra Tape Sentryline Detectable 620" as manufactured by Reef Industries, Inc., Christy's™ or approved equal.

## M. Mortar

Mortar used to repair concrete coated pipe after attachment of the various bond or test wires shall be fast drying, non-shrinkable type. Refer to Standard Specifications Section 03300.

## N. Insulating Blanket

The insulating blanket shall be a 1/8-inch thick neoprene or butyl insulating material. The width and length of the blanket will vary due to diameter of the pipelines to be insulated. The width and length shall be 12-inches larger than the diameter of the largest pipeline to be insulated.

## O. Casing Seal

The casing seal shall be composed of an irradiated, semi-rigid polyolefin sleeve which when exposed to temperatures in excess of 250°F will shrink from its original diameter to a predetermined recovered diameter. Casing seal shall be Raychem Caseal, or approved equal.

## P. Reference Electrodes

Reference electrodes shall be copper-copper sulfate (CSE) suitable for direct burial, and shall remain stable for at least ten years. The reference cell shall be capable of maintaining a potential within 15 millivolts of a freshly made cell while drawing 2 microamperes. Reference cells shall contain a barrier to inhibit migration of chloride ions from the soil into the reference cell.

Reference cell lead wire shall be AWG No. 8, red, stranded copper, with high-molecular weight polyethylene (HMW-PE) insulation suitable for direct burial use. HMW-PE insulation shall conform to ASTM D1248, Type 1, Class "C", Category 5, Grades E4 and E5 with tensile strength J1, J3.

The lead wire shall be silver soldered to the copper core of the reference cell with the connection epoxy sealed according to the manufacturer's recommendation. Copper sulfate cell shall be located next to the pipe in native soil near the spring line.

## PART 3 - EXECUTION

### A. General

Cathodic protection installation shall conform to NACE Publication RP0169 (Latest Revision) – *"Recommended Practice, Control of External Corrosion on Underground and Submerged Metallic Piping Systems"*, and to NACE Publication RP0286 (Latest Revision) – *"Recommended Practice, Electrical Insulation of Cathodically Protected Pipelines."*

### B. Pipe Lead Attachments

Pipe leads shall be attached to the pipe and shall terminate at the test box without a splice. A minimum of 18-inches of slack wire from each lead shall remain in each test box.

### C. Attachment of Wire to Pipe

1. Surface Preparation for Alumino-Thermic Welding: Any existing coating on the pipe shall be removed by making a 3-inch square window in the coating. The exposed metal surface shall be cleaned to produce a bright metal finish, equivalent to SSPC SP-10, "near white."

2. Alumino-Thermic Weld: The attachment of copper wire shall be made using an alumino-thermic weld as shown on Standard Drawings CP-9 or CP9A. Remove only enough insulation from the wire to allow the weld connection to be made. The wire shall be held at a 30°-45° angle to the surface when welding. One wire only shall be attached to each weld.

3. Weld Test: As soon as the weld is cool, the weld shall be tested by striking a sharp blow with a 3-pound hammer while pulling firmly on the wire. All unsound welds shall be rewelded and retested.

4. Wire Locations: Wires shall be attached to the top (horizontal) surface of the pipe. Where two or more wires are required welds shall be at least 12-inches apart, along the pipe length.

5. Alternative Attachment Methods: The weld mold may not fit between the pretension bars of concrete cylinder pipe, depending on the diameter and pressure class of the pipe. Alternate methods of attachment include:

    a. thermite welding the test wire to the bell ring at a joint, or

    b. arc welding a 1/4-inch diameter steel bar, with test wire pre-attached, to the steel cylinder between pretension bars, or

c. pin-brazing utilizing equipment and approved installation procedures from BAC® Corrosion Control.

## D. Dielectric Coating Over Thermic Weld Connection

After completing the thermic weld connection between the wire and the pipe, the connection shall be coated in accordance with the following table:

| Pipe Material | Connection Coating |
|---|---|
| Cement-mortar coated steel | Koppers Bitumastic 505 or approved equal and cement mortar |
| Carbon steel, Ductile iron | Thermic weld cap |

Cement mortar coating shall be of the same material and thickness as specified for the pipe.

## E. Backfill Over Wire

Buried wire shall be installed at a minimum depth of 36-inches. The trench bottom shall be level and free of exposed rocks. The first 12-inches of backfill over and the 6-inches under the cable shall be sand per District bedding requirements. Refer to Section 02223. The remainder of the trench shall be backfilled with stone-free soil and compacted to 95% relative compaction in accordance with ASTM D1557. Detectable warning tape shall be installed 12-inches above the wire.

## F. Test Stations

1. At Grade Test Boxes: Concrete test boxes shall be located as shown on the plans or Standard Drawings, and shall be positioned as close to above the pipeline as practical. Concrete boxes shall be installed on a 6-inch deep base of 3/4-inch crushed rock.

2. Two-Wire Test Box Spacing: Two-wire test boxes shall be placed at intervals not to exceed 500 feet and at the end-points of all metallic pipelines and casings.

## G. Joint Bonding Wires

Joint bonding wires shall be installed on ferrous metal pipelines at all unwelded joints, fittings, valves, and flanges (excluding insulating flanges) as shown on Standard Drawings CP-10, CP-11, and CP-12. Two bond wires shall be welded across joints for pipe diameters under 18-inches. Three bond wires shall be welded across joints for pipe diameters 18-inches and larger. Bond wires shall be attached using the alumino-thermic weld process. Bond wires shall not be attached to valve bodies, but instead to the valve flange.

## H. Flange Insulation Kits

Flange Insulation Kits shall be installed as follows:

1. Cleaning: Faces of flange pairs shall be cleaned of all dirt, rust or fouling materials which would interfere with a watertight joint and insulating properties of the flange kit.

2. Alignment: Alignment pins shall be used to properly align the flange and gasket. The manufacturer's recommended bolt tightening sequence shall be followed. Bolt insulation sleeves shall be centered within the insulation washers so that the insulating sleeve is not compressed and cracked.

3. Locations: A cathodic protection bonding test station shall be installed at each buried flange insulation. Two test wires shall be installed on each side of the buried insulator according to this specification and details of the plans.

4. Insulation Kits at Valves: Flange insulation kits installed directly against butterfly valve flanges shall use half-length insulating sleeves for threaded bolts near the valve bonnet and base.

## I. External Insulating Flange Coating

1. Buried Insulating Flange Coating:

   a. Primer: Surface shall be cleaned of all dirt, dust, and loose rust or mill scale by wire brush and by wiping with a clean cloth. The surface shall be dry. Apply primer by hand or brush. A thick coating of primer shall be worked into all crevices, around bolts and in threads, and shall completely cover all exposed metal surface. The primer should overlap the pipe coating by 3-inch minimum.

   b. Wax-Tape: The petroleum wax-type can be applied immediately after primer application. Short lengths of tape shall be cut and formed completely around each individual bolt and stud-end. After all bolts are covered, the tape shall be applied circumferentially and formed by hand into all voids and spaces. There shall be no gaps or air spaces under the tape. The tape shall be applied with at least 55% overlap.

   c. Outer Covering: The clear plastic outer covering shall be applied by hand such that the material conforms and adheres to the wax-tape surface. Two layers of plastic outer wrapping shall be applied.

2. Above Ground Insulating Flange Tape Coating: All flange and pipe surfaces shall be clean and free of all dirt, grease, water, and other foreign material prior

to installation of tape coating. The two separate tapes shall be half-lapped twice over the outer surface of the flange.

## J. Internal Coating at Insulating Flange

The interior of the pipeline shall be coated for a distance of two pipe diameters in each direction away from the insulating flange. At an insulated valve flange, interior of pipeline shall be coated away from the valve for a distance of two pipe diameters. Coating shall be as specified in Section 09900, Painting and Coating, System B-1 or B-2 as appropriate.

1. Surface Preparation: The surface preparation of the mortar lining shall consist of wire brushing to remove all loose mortar to provide a suitable surface for adhesion of the coating.

2. Application: Coating shall be applied by brushing until a minimum coating thickness of 20 mils is achieved. Each ensuing coat shall be applied before subsequent coat cures, usually within 3 to 6 hours after subsequent coat has been applied.

## K. Zinc Anodes

Where called for on the drawings, prepackaged zinc anodes shall be installed in excavated, drilled, or punched holes a minimum of 3-inches larger in diameter than the prepackaged anode diameter. Anodes shall be installed below the level of the water main, with a minimum separation of 2-feet between the main and the zinc anode maintained at all times. Anodes shall not be lowered, transported, handled, or lifted by the lead wire.

1. Backfilling: After the prepackaged anode is placed in the hole, water shall be poured into the hole so that the anode is completely covered with water. Stone-free native soil shall then be used to backfill the anode hole. Imported sand shall not be used for backfilling. The anode hole shall be backfilled in stages and carefully compacted to ensure that no voids exist around the bag and that the bag and anode wire are not damaged. After backfill is level with the top of the anode, a minimum of 15 gallons of water shall be poured into the hole to completely saturate the soil backfill. More water shall be added if it is suspected that the backfill is not completely saturated. Care shall be taken to avoid damage to the anode and anode lead wires.

2. Anode Lead Wire: Sufficient slack shall be provided in the wire, and it shall be coiled in the test station box.

## L. Identification Tags

Identification tags shall be securely attached to each of the wires in the test box. Tags shall be stamped "P" for pipe, “C” for casing, and "A" for anode to indicate to which structure each wire is attached. Tags stamped for pipe shall include identification of pipe diameter, material, and appropriate pipeline station number. See Standard Drawing CP-6 for details.

Tags on wires in the test box at insulating flanges shall be stamped "N", "S", "E", or "W" for North, South, East, or West and with the pipeline diameter to indicate on which side of the insulating joint and to which pipeline the wires are attached.

## M. Insulating Blanket

Install an insulating blanket as shown in the Standard Drawings between any metallic pipelines that cross or parallel each other when the distance between the two pipelines is less than 18-inches.

## N. Casing Seal

The casing seal shall be installed wherever a metallic pipeline passes through a casing. The casing seal shall be installed according to the manufacturer's recommendations.

## O. Earthwork

Trenching, backfilling, and compacting shall be in accordance with Standard Specification Section 02223.

## P. Required Test and Record Keeping

The Contractor shall furnish all necessary equipment, material and qualified personnel required to perform all tests described herein.

1. Continuity Tests: The Contractor shall notify the District’s Representative when continuity bonding has been completed and all test boxes have been completed. A registered corrosion engineer retained by the Contractor shall test and measure the electrical continuity of metallic pipelines. The pipeline shall be considered electrically continuous when the measured longitudinal resistance of the pipeline between each pair of adjacent test stations is no greater than 20 percent higher than the theoretical resistance of that section of pipeline.

   If tests indicate that adequate electrical continuity has not been achieved, the Contractor shall excavate to investigate and locate improperly bonded joints and shall make repairs until electrical continuity is achieved to the satisfaction of the District.

2. Test Stations: The Contractor shall notify the District's representative when insulator test box wires, two and four wire test station wires are ready for testing. The wires shall remain disconnected to facilitate testing. A registered corrosion engineer retained by the Contractor shall conduct the tests to certify that none of the wires were damaged or broken during the installation. If test indicate damage, the entire wire shall be replaced and retested at the Contractor's expense.

   Records shall be made of all test stations and reference electrode tested and submitted to the District.

3. Insulation Joints: The Contractor shall test each insulated joint with the insulator tester in accordance with the manufacturer's written instructions. All damaged or defective insulation parts shall be replaced and retested. Records shall be kept of all insulated joint tests and shall be submitted to the District in a final report.

4. Anode and Pipe Lead Wire Integrity Tests: After the pipe and anodes are buried, the pipe lead wire and anode lead wire trenches are backfilled, and the test boxes are installed, the Contractor shall notify the District's representative that the anode and pipe lead wires are ready for hookup and testing. The wires shall remain disconnected to facilitate testing. A registered corrosion engineer retained by the Contractor shall conduct the tests to check that none of the anode wires or pipe lead wires were damaged or broken during the installation. Each anode lead wire will be tested for electrical continuity to the anode by measuring the anode's potential with respect to a copper copper-sulfate reference electrode. The measured open circuit potential of the anode shall be as specified in the project technical specifications, and a potential less than that indicates a broken wire or faulty anode installation in which case the anode shall be replaced.

5. Acceptance: The Contractor shall submit a stamped final report and drawing(s) both in two hardcopies and in an electronic format by the corrosion engineer stating that the facilities are performing satisfactorily. All test made must be reviewed and approved by the District before the corrosion control work is accepted. The District reserves the right to spot check any or all tests performed by the Contractor. All construction defects must be repaired and retested before the final acceptance is made. All unacceptable tests must be re-performed by the Contractor at no additional cost to the District.

**END OF SECTION**