SECTION 6.4
PRESSURE SYSTEMS (FORCE MAINS)

6.4.1 PURPOSE

The purpose of this section is to provide guidelines for the use, location, alignment and design of pressure sewer pipelines for conveying raw sewage.

6.4.2 STANDARD TERMS AND DEFINITIONS

Wherever technical terms occur in these guidelines or in related documents, the intent and meaning shall be interpreted as described in Standard Terms and Definitions.

The following terms and definitions as found in this section shall have the following meaning:

Force Main: Pressurized pipeline used to convey wastewater from a lift station to a gravity sewer main.

Lift Station: A pump station used for lifting sewer flows from a lower to a higher elevation.

6.4.3 GENERAL

It is the responsibility of the user of these documents to make reference to and/or utilize industry standards not otherwise directly referenced within this document. The Engineer of Work may not deviate from the criteria presented in this section without prior written approval of the District's Engineer.

A. Use and design of sewer pipelines shall be in accordance with Section 6.1.

6.4.4 GUIDELINE

A. General Requirements

1. Dual Force Mains: The use of dual force mains shall be as directed by the District Engineer. Dual mains may be required where maintenance will be required on a regular basis or due to environmental constraints such as sensitive habitat areas. Each force main shall include the following: isolation valves, check valve, air vac, emergency pump connection, and valved drainage line into the wet well (located inside the dry well). This shall allow use of either force main should the second line require draining and repair.

2. PVC Pressure Pipe: PVC pipe is the preferred material for force mains. Force main fittings and appurtenances shall be ductile or cast iron. Analyze pipeline stresses to PVC that will occur with pressure on/off cycles and surge pressures to ensure the PVC will operate over the working life of the pump station (50 years). Use a roughness coefficient that is appropriate for PVC pipe at the end of its planned design life. However, the minimum pressure class for all stations regardless of total dynamic head requirements shall be at least Class 235.

3. Ductile Iron Pipe (Special Station Requirement): Epoxy lined and coated ductile iron pipe may be specified for force mains in special cases, with prior approval by the District Engineer. This may include high lift stations (total discharge head greater than 100 psi) where the initial length of the force main to the property line (where access for repair is typically difficult due to the depth of pipe) may be constructed of ductile iron. Considerations must be made for corrosion monitoring and protection.

4. Force Main Isolation Valves: Install isolation valves on each force main both inside the dry well (located near the wall penetration) and outside the station within the fenced-in area (located upstream of the emergency pump connections).

5. Flex Couplings at Pump Station Wall: Install dual flexible couplings (dresser couplings) or ball and socket type fittings outside the station on the force main to allow for differential settlement.

6. Corrosion Protection: All buried ferrous pipe, fittings, and valves shall be coated as specified in the contract documents. Prior to backfill, all fittings shall be coated with a wax tape system. All fasteners on buried fittings shall be stainless steel Class 316.

7. Thrust Blocks: Provide thrust blocks at bends on the force main. In constructing the mains, ensure that at bends, each force main thrust block is installed against undisturbed soil. Vertical thrust restraining clamps on siphon high points shall be specified as required to restrain the pipe. Refer to Section 5.2 for use of thrust blocks.

8. Restrained Buried Pipe Joints: Specify restrained mechanical joints as required in special areas (steep sloped areas, fill areas without sufficient resistance to thrust) to ensure security of joints. Indicate locations of restrained joints on the drawings. Fittings that provide joint thrust restraint and/or joint rotation shall be provided as required, PEBA IRON, Megalug or Flextend respectively. Perform restrained length calculations where required to determine if restrained joints are required.

9. Cut-Off Walls: Cut-off walls per Section 02202 shall be used as required for piping on steep slopes. Provide vertical thrust restraint and/or joint rotation fittings, i.e., for subsidence allowance as required.

10. Use of 45-Degree Elbow fittings: To reduce the potential for stoppages where a 90-degree change of direction in the force main is required, show and specify two 45-degree elbows or a horizontal curve instead of a 90-degree elbow.

11. Force Main Drains: (Special Station Requirement): If low points exist in the force main, install valved drains at these points to allow localized draining of the force main to suitable locations to facilitate repairs.

12. Force Main Separation and Pipe Joint Stagger: Construct the force mains in separate trenches with a minimum 5 feet separation between their outer surfaces. Plans should contain a notation for staggering the pipe joints to lessen potential undermining if a leak occurs in either force main.

13. Use of Combination Air Valves: Where at all possible, force mains shall be designed with a continuous uphill slope without high points so that air-release valves are not required on the force main. If the force main cannot be designed this way, provide two (2) redundant air-release valves at high points where there are siphons or at discontinuities in grade. Combination air-release valves (i.e., two body valves to allow air release during filling, air release for trapped air under pressure, and air entry (vacuum relief) during pipe emptying,) shall be installed inside a vault to allow access to the valves for maintenance. All piping and valve appurtenances within the vault shall be Type 316 stainless steel. Discharge from the air vent shall be piped to the nearest sewer manhole. If a manhole is not located within suitable distance, install a separate vault with activated charcoal canister for odor control of the air valve discharge.

B. Isolation Valves and Emergency Pumping Connection

1. Solid Wedge Type Valves: For buried applications, provide "solid wedge" type gate valves for sewage applications with the following features: type 316 stainless steel stem, gate, and seat inserts, stainless steel fasteners in wetted areas, and fusion bond epoxy on all ferrous parts. Valves shall be designed for buried service with water tight bonnet and buried service gear operator.

2. Isolation Valve Location: Install isolation valves inside the station fenced-in area. Where difficult soil conditions exist or where valves may not be easily accessible, install the valves in a vault for easy access. Isolation valves shall be installed on each force main both inside the dry well (located near the wall penetration) and outside the station within the fenced-in area (located upstream of the emergency pump connections).

3. Force Main Drain Lines: Install valved drain lines on each discharge line manifold in the pump room for draining each force main individually back into the wet well (use during maintenance to repair leaks in one force main while operating the second force main).

4. Emergency Pumping Connections: An emergency pump discharge connection shall be built into both force mains. This **assembly** shall be designed as follows: locate a "wye" fitting on each force main downstream of the flex couplings and force main isolation valve. Extend the side outlet of the wye to an isolation valve and blind flange in a service box vault (use Type 316 stainless steel bolting for corrosion resistance). Size each service box large enough for connections of large diameter flexible discharge hoses from emergency pumps. Orient the blind flange at 45 degrees up from horizontal for ease of connecting hoses in the service box vault. During emergencies which require draining the force main or bypassing the station pumps, a portable pump will be connected to this assembly. The minimum allowable diameter size for the connection is 6 inches. The District Engineer may elect to use a quick connect coupling instead of the blind flange in order to facilitate an emergency connection where time will be critical. (Note: this emergency connection can also be used as a cleanout.)

5. Valving Diagram: Specify a wall mounted plastic laminated diagram in the station that shows the location(s) of the dual force mains and the force main valving on the site. This sign shall also note the maintenance schedule for exercising and testing the force main isolation valves.

6. Eccentric plug valves: Specify eccentric plug valves with tight shut-off with pressure in either direction (a distinct advantage in sludge pipelines with multiple flow routings) to provide flexibility.

C. Discharge Manhole

1. Discharge Manhole: The force main will typically discharge into a separate manhole (PVC lined) with gravity discharge into the trunk sewer. Install offset fittings and/or long radius elbows as required in order to enter the manhole at the required height and in the direction of flow in the trunk sewer.

2. Discharge Level to Manhole: If the force main discharges directly into a interceptor sewer, the force main discharge shall be above the flow line of the gravity sewer and in the direction of flow in the trunk sewer (to prevent back flooding into the wet well with leaking check valves).

D. Odor Control

1. Chemical Odor Control: Force mains longer than one mile with excessive detention times of more than 24 hours can create odor problems in downstream discharge sewers. If required due to downstream sewer conditions, provide an odor control system which can include chemical injection into the wet well such as calcium nitrate or other approved chemicals. Long force mains are defined as pressure pipelines grater in length than one mile.

2. Dedicated Gravity Discharge (Special Station Requirement): In some cases, a dedicated force main gravity discharge line to a trunk sewer may be required to prevent odors on existing gravity mains and laterals.

E. Allowable Pipe Velocities

1. In general, the maximum recommended suction pipe velocity is 5 fps. Velocity at the suction bell shall not exceed 3.5 fps. Install a larger suction line than the pump inlet diameter if required to reduce velocity and inlet head losses, in order to provide the required net positive suction head (NPSH) according to the Hydraulic Institute, and prevent cavitations for high flow rate pumps.

2. The maximum recommended velocity in the station discharge piping is 8 fps. The minimum discharge velocity in the force main shall be 4 fps at a designed capacity in order to achieve cleansing velocity.

3. Suction and discharge pipe design shall follow Hydraulic Institute recommendations for items not addressed above in this Section.

6.4.5 NOTATIONS ON PLANS

Sewer pressure mains shall be shown in the plan and profile views of the sheet(s) and shall include, but not be limited to the following:

A. Standard symbols, stationing and plan callouts in accordance with Section 1.1.

B. Plan View: Indicate size, class, type of pipe materials and locations of laterals, manholes and pipe connections in accordance with Section 1.1.

C. Profile View: Indicate size, class, type of pipe materials and locations of manholes, flow-line/invert elevations, and slopes in accordance with Section 1.1. If vertical curves cannot be avoided the curve shall be indicated by showing invert elevations at fifteen foot (15') to twenty five foot (25') intervals.

6.4.6 REFERENCE

Should the reader have any suggestions or questions concerning the material in this section, contact the District Engineer.

The publications listed below form a part of this section to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said publications unless otherwise called for. The following list of publications, as directly referenced within the body of this document, has been provided for the user's convenience. It is the responsibility of the user of these documents to make reference to and/or utilize industry standards not otherwise directly referenced within this document.

1. Valley Center Municipal Water District Standards:
    a. Design Guidelines
        i. Section 1.1, Drafting Guidelines
        ii. Section 1.5, Easements and Encroachments
        iii. Section 4.2, Sewer Planning
        iv. Section 6.1, Gravity Sewer Pipeline Design
        v. Section 6.2, Sewer Manholes and Cleanouts
        vi. Section 6.3, Sewer Laterals
    b. Standard Drawings
    c. Approved Materials List for Sewer Facilities
    d. Technical Specifications
        i. Section 15064, Polyvinyl Chloride (PVC) Pressure Pipe
2. American Society for Testing and Materials (ASTM):
    a. ASTM D3034, Type PSM Poly (vinyl chloride) (PVC) Sewer Pipe and Fittings.
    b. ASTM F 794, Poly (vinyl chloride) (PVC) Profile Gravity Sewer Pipe and Fittings.
    c. ASTM A 536, Standard Specifications for Ductile Iron Casings

END OF SECTION