

DESIGN AND CONSTRUCTION STANDARDS

SECTION 6 – WASTEWATER FORCE MAINS

6.1 General Requirements

Wastewater force mains are to be constructed solely for the conveyance of sanitary waste. Under no circumstances shall any roof drains, foundation drains, or surface or subsurface drains be either directly or indirectly connected to any part of the sanitary sewer system.

In addition to the Standards herein, the design must comply with all applicable federal, state, and local regulations and standards. These regulations and standards include, but may not be limited to:

Virginia Department of Environmental Quality (DEQ), *Sewage Collection and Treatment (SCAT) Regulations*

<http://law.lis.virginia.gov/admincode/title9/agency25/chapter790/>

Hampton Roads Planning District Commission (HRPDC), *Regional Construction Standards, 6th Edition*

<https://www.hrpdcva.gov/555/Sixth-Edition-Current-Standards>

American Water Works Association (AWWA), *Standards*

<http://www.awwa.org/publications/standards.aspx>

American Railway Engineering and Maintenance-of-Way Association (AREMA), *Manual of Railway Engineering*

https://www.arema.org/AREMA_MBRR/AREMA_MBRR/AREMAStore/MRE.aspx

6.2 Technical Design

A. System Layout

1. Force mains shall have a net positive slope from the pumping station to the point of discharge unless site-specific conditions make it impractical.
2. Extra depth of bury shall be provided in lieu of air or air/vacuum relief valves wherever feasible. Every effort shall be made to maintain the force main below the hydraulic gradient. If extra depth is not feasible, manually operated air relief valves designed for installation on sewage force mains are to be installed at high points in the force main in an approved structure with adequate means of drainage and flushing. The riser for the air relief valve shall be copper.

B. Capacity Design

1. Force mains shall be designed and sized to carry the maximum peak flow from the pumping station to the discharge terminus.
2. Every effort shall be made to maintain a full force main under all operating conditions.
3. At pumping capacity, a minimum scouring velocity of three feet per second is required. The maximum allowable velocity in the force main shall be eight feet per second.
4. Force mains shall be four inches or larger in diameter. However, if a grinder pump station system is utilized, the force main shall be a minimum of three inches in diameter.

C. Structural Design

1. The proper strengths shall be determined and indicated for sewer pipe materials being specified. Strength shall be based on factors such as pipe size and type, pressure conditions, proposed depth, width of trench, bedding conditions and existing ground conditions. Bedding shall be crushed stone or gravel aggregate conforming to VDOT No. 57 stone and installed in accordance with City Standard Details CWS 05 and CWS 06.
2. A minimum of PVC (DR18) or Thickness Class 52 Ductile Iron (lined with Sewpercoat or Protecto 401) shall be used on all force mains with pipe diameters 4" and greater, with restrained joints as necessary. SCH 80 PVC shall be used for force mains 3" in diameter.
3. Force mains that cross VDOT rights-of-way, railways, surface waters and wetlands shall be installed in casing pipe in accordance with Norfolk Modification Details WS 04 01 & WS 04 02 NM Steel Casing. Force mains under railway tracks and across railway rights-of-way shall be installed in casing pipe in accordance with the latest edition of the AREMA Manual of Railway Engineering). Force mains that cross major roadways or come near large obstructions shall be installed in a casing pipe at the City's discretion. Additionally, the following parameters also apply:
 - a. Steel casing pipe shall have minimum yield strength of 35,000 psi.
 - b. The casing pipe shall be electrically isolated from carrier pipe.
 - c. Casing pipe shall be sloped at a minimum grade of 1/16" per foot.
 - d. A leak detector per City Standard Detail CWS 02 shall be provided at each end.

Table 6.1 indicates the minimum wall thickness allowable for casing pipe.

TABLE 6.1

MINIMUM WALL THICKNESS FOR CASING PIPE

CARRIER PIPE DIAMETER (IN.)	PIPE CASING			
	MINIMUM CASING PIPE DIAMETER (IN.)	MINIMUM WALL THICKNESS, inches		
		CRITERIA WITHIN RAILROAD RIGHT-OF-WAY	CRITERIA WITHIN CITY OR VDOT RIGHT-OF-WAY	MINIMUM NUMBER OF CASING SPACER RUNNERS
STEEL WITH PROTECTIVE COATING	STEEL	STEEL	STEEL	
4	12	0.375	0.250	4
6	18	0.375	0.250	4
8	18	0.375	0.250	4
10	20	0.375	0.250	4
12	24	0.375	0.250	4
16	30	0.500	0.375	6
18	30	0.500	0.375	6
20	36	0.563	0.375	6
24	42	0.625	0.500	6

4. Force mains shall be sufficiently anchored within the pump station and throughout the line length. The number of bends shall be as few as possible. Restrained joints and tie rods shall be provided where restraint is required. All buried tie rods shall be fabricated from Type 316 SS. Design calculations and summary table shall be submitted for proposed restraint lengths. Thrust blocks shall not be permitted.
5. The minimum cover depth for force mains shall be 36 inches.
6. The Design Engineer shall consider soil conditions and the potential for stray electrical currents in the case of metallic pipelines and provide suitable corrosion protection where necessary.

D. Other Requirements

1. When a force main terminates at a gravity sewer system, it must enter the receiving manhole with an invert elevation that will ensure a smooth flow transition to the gravity sewer system in accordance with HRPDC Detail with Norfolk Modifications

SS 17 Force Main saxophone connection. The force main shall be designed to enter the gravity sewer system at a point no more than one foot above the flow line of the receiving manhole using the standard saxophone connection detail.

2. Receiving manholes shall be coated with an approved acid resistant cementitious or epoxy coating.
3. Pressure and leakage tests shall meet or exceed the latest version of ANSI/AWWA C600-10, Section 5.2. Under no circumstances shall the pressure in the pipe be permitted to exceed the rated pressure of the pipe. Any force main or section thereof failing the pressure test shall be repaired or replaced to the satisfaction of the Department. The line must then be retested in accordance with AWWA Standards and the project specific specifications.
4. Non-ferrous mains shall have a detectable 10 gage insulated copper tracer wire located on top of the pipe and a non-detectable warning tape 12 inches above tracer wire. The tracer wire shall be looped at each appropriate appurtenance.
5. When a force main terminates at an HRSD force main system, the force main shall connect in accordance with HRPDC Detail SS 18 adopted by Norfolk.
6. A force main valve at the right-of-way/property line shall be installed to distinguish property ownership and responsibility.