

PART B

WASTEWATER COLLECTION SYSTEM STANDARD SPECIFICATIONS

ARTICLE I

GENERAL

- 1.01 Authority. These Specifications are promulgated by the Fountain Sanitation District. The interpretation, enforcement, and revision of these Specifications are hereby delegated to the District Manager.
- 1.02 Effective Date of Specifications. These Specifications shall be in effect immediately upon adoption by the District Board and shall supersede all former standard specifications for installation of wastewater collection system components and other related infrastructure within the District's service area.
- 1.03 Revisions, Amendments or Additions. These Specifications may be revised, amended or added to. Such revisions, amendments and additions shall be binding and in full force and effect when adopted in the manner set forth in Section 1.02.
- 1.04 District Control. These Specifications will apply to the installation, operation and maintenance of all wastewater collection facilities and other related infrastructure under the control of the Fountain Sanitation District.
- 1.05 Organization and Interpretation of Specifications. These Specifications are composed of design criteria and provisions, material specifications, installation specifications and standard drawings. The interpretation of any section or of differences between sections, when appropriate, shall be made by the Manager of the District and his/her interpretation shall be binding and controlling in its application.
- 1.06 Definitions. As used in these Specifications, or in any of the drawings where these Specifications govern, unless the context shall otherwise require, the following words defined shall have the meanings herein ascribed:
- a. District Board. The Board of Directors of the Fountain Sanitation District duly elected or appointed in accordance with applicable statutory requirements.
 - b. District Manager or Manager. The Manager of the Fountain Sanitation District or their designated representative.
 - c. Engineer. The Engineer or consultant of the District, acting either directly or through properly authorized agents, such agents acting within the scope of the particular duties entrusted to them.
 - d. Collection System. Sewer mains and/or wastewater pipelines, together with all appurtenant and necessary manholes, cleanouts, taps, service pipes, and associated materials, easements, property and equipment collecting sanitary sewage from individual customers and/or properties.

- e. Wastewater Main or Sanitary Sewer Main. That portion of the wastewater system which collects sewage from users and conveys that sewage to the District wastewater treatment plant, excluding service lines, but including all necessary appurtenant infrastructure such as manholes.
 - f. Service Line. The sewage collection pipeline extending from the customer or property where wastewater is generated down to and including the connection to the wastewater pipeline or sanitary sewer main.
 - g. Applicant for System Extension. Any person, association, corporation, entity, or government agency desiring sanitary sewer service for premises under their control, often a subdivider, a developer or an owner.
 - h. Main Extension. Extensions to the existing collection system network.
 - i. Contractor. In the context of these Specifications a person or persons, partnership or corporation employed by an applicant for the purpose of installing wastewater system extensions or replacements.
 - j. Inspector. The authorized representative of the District assigned to the project.
 - k. Standard Drawings. District Standard Drawings are a part of these Specifications.
 - l. District. The Fountain Sanitation District is responsible for overseeing the wastewater system's operations.
 - m. Premises. Land, property, building, buildings or other locations and/or facilities where wastewater is generated.
- 1.07 Abbreviations. All references to documents or specifications shall be the latest edition or revision thereof:
- a. ASTM American Society for Testing and Materials
 - b. ANSI American National Standards Institute
 - c. NSF National Sanitation Foundation
 - d. OSHA Occupational Safety and Health Administration
 - e. USGS United States Geological Survey
 - f. DIP Ductile Iron Pipe
 - g. PVC Polyvinyl Chloride Plastic Pipe

ARTICLE II
DESIGN PROVISIONS

2.01 Planning Considerations. The land use and population densities approved for the District shall be used to determine wastewater facility design parameters. Where approved development plans do not exist, the following criteria shall be used unless specific approval for other criteria has been given by the District.

- a. Design Period: The wastewater collection and conveyance systems shall be designed for the estimated ultimate tributary population. The tributary areas shall be studied to determine the area for each projected land use.
- b. Population densities including public use lands:
 - (1) Single-family units at 3.2 persons per unit.
 - (2) Multi-family and condominiums at 2.5 persons per unit.
 - (3) Four (4) single-family units per acre.
 - (4) Sixteen (16) multi-family cluster housing or condominiums per acre.
- c. Per capita flows: Wastewater collection and conveyance systems shall be designed on the basis of not less than the following criteria values unless other values are specifically authorized by the District. The design professional responsible for developing planning and design documents shall inquire of the District as to the specific values for use in each specific project prior to commencing work.
 - (1) One hundred (100) gallons per person per day.
 - (2) Three hundred (300) gallons per capita per day peak flow for submains and laterals.
 - (3) Two hundred fifty (250) gallons per capita per day peak flow for main trunk, interceptor or outfall sewers.
 - (4) Commercial land uses at 1400 gallons per acre per day with a peak factor of 2.
 - (5) Industrial land uses at 1600 gallons per acre per day with a peak factor of 3.
 - (6) Public use, park and open space at 1000 gallons per acre per day with a peak factor of 2.

2.02 Pipe Sizing

- a. Minimum Size.

- (1) No public sewer shall be less than 8 inches in diameter.
- (2) No service line shall be less than 4 inches in diameter.

b. Pipe Size Selection

- (1) Pipe sizing shall be based on the maximum depth of flow being 75 percent of the pipe diameter under peak flow conditions.

2.03 Depth of Cover. In general, sewers shall be designed deep enough to drain basements and to prevent freezing and provide protection from damage from loads applied at the ground or pavement surface. Public mains shall be no less than 9 feet deep measured from the top of the pipe to finish grade unless approved by the District. If public mains are required to be less than 5 feet deep, special protection is required. Special protection shall consist of:

- a. Less than 5 feet but more than 3 feet of cover requires ductile iron, or SDR-26 PVC pipe with reinforced concrete arch. Green SDR-35 PVC plastic pipe material may be used where the depth of cover is more than 5 feet except as otherwise provided for locations where depth of cover exceeds 16-feet.
- b. Less than 3 feet of cover requires site-and project-specific designs. Consultation with the District prior to proceeding is required.
- c. No building sewer shall be less than 5 feet deep in traffic areas without similar special protection listed above except that concrete driveways may be substituted for protection of service lines.
- d. PVC pipe, ASTM D3034, SDR 35 shall not be used where the depth of cover is more than 16 feet. Special analysis and design shall be accomplished to design suitable materials and/or other protection for the pipe. In general, green SDR-26 PVC pipe with protective bedding may be suitable for depths of cover between 16 and 25 feet. Refer to Part C of these Specifications for the requirements for protective bedding.

2.04 Minimum Pipe Slopes. All sewers shall be designed to transport average sewage flows at a minimum mean velocity of 2 feet per second based on Manning's roughness factor of 0.013. The slope between manholes shall be uniform. In no case shall the slope be less than the following for sewer mains and services:

Minimum Pipe Slope

a. Services

- (1) 4 Inch diameter: 2% or 1/4 inch per foot
- (2) 4 Inch diameter: Ductile iron pipe - 1% or 1/8 inch per foot
- (3) 6 Inch diameter: 1% or 1/8 inch per foot

b. Mains

- (1) 8 Inch diameter: 1.0%

- (2) 10 Inch diameter: 1.0%
- (3) 12 Inch diameter: 0.50%
- (4) 15 Inch diameter: 0.50%
- (5) 18 Inch diameter: 0.50%

2.05 High Velocity Protection

In the case of sewers where the slope is more than 15 percent, special provisions as determined by the District shall be made to prevent excessive erosion of material surfaces or displacement by impact. Such high velocity protection shall be shown on detailed construction drawings and approved by the District on a case-by-case basis.

2.06 Alignment.

a. Sewers in Streets

- (1) Collection system sewers shall be placed on the centerline of street sections located midway between curb and gutter on each side of the traveled surface.
- (2) On streets running north and south where it is not possible to locate the pipe on centerline, the sewer line shall be placed no more than 10' (ten feet) west of the centerline of the street.
- (3) On streets running east and west where it is not possible to locate the pipe on the centerline, the sewer line shall be placed no more than 10' (ten feet) south of the centerline of the street.
- (4) On streets shaped as a "U" or on streets having unusually sharp turns, the sewer line will conform to the above specifications as near as is practical, but the final locations shall be as determined by the Engineer or other District representative. Curvilinear sewer mains shall not be allowed without prior approval of the District. Designs must attempt to minimize the use of manholes and maximize the operability and maintainability of the collection system.
- (5) In no case shall the sewer line be installed closer than 5-feet to the lip of the pan or gutter.
- (6) Minimum centerline radius for PVC pipe must equal 270-feet or 3-degree bends will be required. Nothing smaller than 14-foot-long pipe segments may be used for a centerline radius of 270-feet.

b. Sewers in Easements

- (1) All sewer easements must be a minimum of 30' (thirty feet) in width and must be prepared in accordance with Part I of the District Sewer Use Regulations.
- (2) No sewer shall be located less than 15' (fifteen feet) from the edge of the easement.

- (3) All sewer lines in easements between lots shall be constructed with ASTM D3034 SDR-26 PVC pipe per Section 3.01.
- c. Landscaping Trees – All trees must be 15 feet away from any sanitary sewer main line.

2.07 Pipe Alignment in Manholes

- a. Intersections. All pipes shall have free discharge into the collection system. The basic design criteria to be applied will result in the hydraulic grade line (HGL) of flows into a manhole being higher than the HGL at the outlet of the manhole.
- (1) The pipes entering the manhole will be set at an elevation to match the maximum allowable depth of flow (75% of pipe diameter) with the HGL at the manhole outlet pipe under maximum allowable depth of flow with an allowance for headloss in the manhole channel.
 - (2) Unless the design conditions obviously dictate otherwise, head loss in the manholes will be accounted for by setting all manhole inverts with a 0.1-foot drop except for changes in alignment in excess of 30° shall have a 0.3-foot drop in the invert through the manhole. Refer to other design criteria herein where comparative HGL elevations will govern the design.
 - (3) Where two or more pipes enter the manhole, the pipe elevation and/or HGLs shall be established to match.
 - (a) Unless dictated otherwise by a detailed hydraulic analysis, the flowline of two or more pipes entering a manhole will be at least 0.3 feet above the flowline of the pipe flowing out of the manhole.
 - (4) Changes in direction at intersections shall not be greater than 90°.
 - (5) When the intersecting pipe is smaller in diameter than the pipe exiting the manhole, the crown or inside-top of the intersecting pipe shall match the crown or inside-top of the main pipe entering the manhole unless detailed hydraulic computations indicate the intersecting pipe should be higher to match hydraulic grade lines with head loss. In no case shall the difference in elevation between the flowline of the pipe exiting the manhole and the flowline of the intersecting sewer be less than 0.3 feet.
- b. Increasing Size. When sewers are increased in size with no intersecting sewers, the invert of the larger sewer shall be lowered sufficiently to maintain the same energy gradient.

2.08 Manhole Location

- a. Manholes shall be installed at the end of each line, at all pipeline intersections, changes in grade, size, alignment and at intervals not greater than 400 feet.

- b. Manholes must be located to allow unassisted and unrestricted access by District maintenance vehicles. Lines and manholes located in areas where access, in the opinion of the District, is not possible or may cause safety concerns will not be approved for construction.

2.09 Manhole Design Details

a. Manhole Sizes.

- (1) Inside diameter not less than 5 feet on lines 8 inches through 30 inches in diameter.
- (2) Inside diameter not less than 6 feet on lines 36 inches through 54 inches in diameter.
- (3) Six (6) foot diameter manholes will be required for any manholes with four (4) penetrations.
- (4) Special consideration at the sole discretion of the District shall be applied for manholes greater than 25-feet in depth.
- (5) If pipelines larger than 60 inches in diameter are necessary or other special conditions exist, special design considerations will be necessary as determined by the District in its sole discretion.
- (7) Apex manholes will not be allowed unless otherwise approved on a case-by-case basis.
- (8) All manholes must be concentric in design.

b. Drop Manholes.

- (1) External drop manholes will be permitted only in extreme and special conditions where approval has been granted by the District.
- (2) As a general criterion, a minimum difference in elevation of 1.5 feet between the inlet and outlet is required before considering use of drop manhole design.
- (3) The maximum amount of vertical drop allowable in a drop manhole shall be 10 feet.
- (4) Where drop manholes are required, design of an internal drop shall be accomplished using the RelinerTM product or an acceptable equivalent. All metallic hardware shall be type 316 stainless steel.
- (5) All drop manholes must be completely lined with coal tar epoxy 45 mils thick or an acceptable form of protective coating.
 - (a) ICS Devoe DextorTM

(b) Amine-cured epoxy, Raven Lining Systems, Inc., "Raven 405"

c. Manhole Channels.

- (1) The flow channel shall be made to conform to the slope and shape of the sewer pipe entering and exiting the manhole.
- (2) The channel shall be formed from cast-in-place concrete to a cross-section matching the circular pipes.
- (3) The channel shall be constructed with vertical walls from a point one-half the pipe diameter above the channel flowline as shown in the standard drawings.
- (4) At intersections with other lines, channels shall be formed with a curve to minimize turbulence.
- (5) The flow channel shall be constructed to have a minimum depth equal to the pipe diameter. Refer to standard drawings.

d. Manhole Gaskets.

- (1) The pipes entering and exiting the manhole shall be equipped with a manhole gasket placed around the pipe and cast in the base.
- (2) A precast base shall use a pre-manufactured rubber gasket in the precast base section such as a Kor-N-Seal™ boot or approved equivalent pre-manufactured pipe fitting.
- (3) Manholes constructed on existing pipelines with a site-cast, cast-in-place base shall be constructed with waterstop gaskets.
 - (a) Volclay RX-101; two circumferential gaskets/waterstops, 4 inches apart, at each pipe embedment
 - (b) Cast-in-place bases must cover the waterstop a minimum of 6-inches.

e. Rings and Covers.

- (1) The ring and cover shall be constructed of cast iron for traffic bearing conditions and cast aluminum or cast iron for non-traffic bearing conditions.
- (2) All manholes located outside of dedicated street or alley rights-of-way will be designed and constructed with a locking type cover and the ring bolted to the concrete cone.
- (3) Grade adjustment rings between the ring and cover and the concrete cone cap shall not exceed 6 inches in total height.
- (4) The District shall specify the use of special manhole cones with identity logos,

impressions, or castings.

f. Cone and Barrel Sections

- (1) Watertightness. Precast concrete manhole joints shall be made watertight. Manholes of brick or segmented block shall not be used in the sanitary sewer system. Refer to Article III of these Regulations for material specifications.
 - (a) Each precast manhole segment shall be joined with a rubber "O" ring, Ram-Nek, Con-Seal or similar approved material. Each segment shall be full bed and double wrapped.
 - (b) All exterior MH joints shall be double wrapped with 12" wide elastomeric joint wrap.
 - (i) Henry Company RUB'R NEK[®] External Concrete Joint Wrap or approved equal.
 - (c) All exterior concrete manhole surfaces shall be coated with a chemically cured high build epoxy dampproofing material.
 - (i) ICS Devoe Devtar 5A
 - (d) Where ground water is present or, in the opinion of the District, ground water could be present, all exterior joints shall receive a 3/8" to 1/2" thick coating of cement grout. The joint shall be double wrapped with 12" wide elastomeric joint wrap covering and adhered to the joint area extending at least 6 inches each side of the joint.
- (2) Waterproofing materials shall be applied to clean, dry surfaces in accordance with the coating manufacturer's written instructions/recommendations and the following:
 - (a) Preparation
 - (i) Examine surfaces to receive waterproofing to assure conditions are satisfactory for application of materials
 - (ii) Remove dirt, dust, sand, grit, mud, oil, grease, and other foreign matter
 - (iii) Brush down surfaces to remove all loose scale, fins, dust, etc.
 - (iv) Complete surface preparation in accordance with manufacturer's recommendations
 - (b) Application
 - (i) General
 - 1) Apply in three (3) coats with high pile rollers or by spray equipment
 - a) Minimum air pressure: 90 psi
 - b) Spray apply in a fine mist
 - 2) Provide adequate forced ventilation when applying coating in

enclosed spaces

- 3) Do not use benzol or other volatile solvents for thinning coating
 - (ii). First coat:
 - 1) Apply only when surface of concrete is dry and at a suitable temperature for adequate penetration
 - 2) Thin as recommended by manufacturer
 - 3) Apply for maximum penetration
 - 4) Absorbed by concrete within 5 to 30 minutes of application so no continuous film remains on surface
 - (iii) Second coat: Cover surface with 5 mil film
 - (iv) Third coat: Produce a high gloss 5 mil film
 - (v) Cure material as recommended by manufacturer
 - (vi) Do not cover with backfill until installation is accepted by inspector

g. Stub Outs from Manholes.

- (1) Stub outs from manholes shall generally not be allowed except for lines which are known to be extended for future construction/development and shall not exceed 40 feet.
 - (a) When stub outs are allowed, installation must provide for future excavation of the stub out to adjust pipe to the proper grade.
- (2) Whenever practical, designs to complete the manhole run shall be submitted to the District Manager for review to insure proper grade and alignment for future construction/development.
 - (a) Future extension of stub outs shall be of like material using the same pipe slope and alignment.
 - (b) Any stub outs from manholes shall be plugged with a watertight and airtight glue cap fitting. Whenever practical, capped end shall be marked for future location reference.

h. Design Features for Deep Manholes.

- (1) Manholes which are more than sixteen (16) feet from the finished cover to the pipe invert shall be considered deep manholes subject to special design. The items given below shall be given special attention and subject to approval by the District.
 - (a) Structural integrity of precast or cast-in-place concrete structures shall be verified and certified by the responsible design professional for all manholes in excess of 16-feet in depth.
 - (i) Specific attention shall be given to concrete thickness, reinforcing

design and concrete strength.

i. Underdrain.

- (1) Where an underdrain must be used, the underdrain must be carried under or around the manhole base.
 - (a) Underdrain must have a minimum of 3-feet of horizontal separation, edge of pipe to edge of pipe.
 - (b) Underdrain must be placed a minimum of 1.5-feet below the sewer line, flow line of sewer pipe to top of underdrain pipe.
- (2) In no case shall any underdrain, sump pump or trench drain be connected to the public wastewater system.
- (3) Components of an underdrain system shall not penetrate or be attached to any part of the wastewater collection system of the District.
- (4) All Underdrain piping shall be white to preclude accidental cross-connection of the drainage systems.

j. Service Connection to Manholes.

- (1) No sewer service lines will be allowed to connect to manholes.
- (2) No sewer service shall connect to the main line closer than 5' to the exterior of a manhole.

2.10 Relation to Water Mains and Water Supplies.

- a. Wastewater pipelines shall be located a minimum of 10 feet horizontally from existing or proposed water mains, edge of pipe to edge of pipe. Wastewater pipelines shall be a minimum of 18 inches clear distance vertically below the water main.
 - (1) If this clear distance is not feasible, the crossing must be designed and constructed so as to protect the water main from potential cross connections and minimize the potential for structural damage to either pipeline.
 - (2) Install in accordance with the Colorado Department of Public Health and Environment (CDPHE) Design Criteria for Wastewater Treatment Works, Section 3.2.12 most recent revision and these Specifications, whichever is more stringent.
 - (3) Minimum protection shall consist of the installation of an impervious and structural sewer.
 - (a) Where the sewer pipe is above the water main, regardless of separation, one length of ductile iron pipe at least 18 feet long centered over the water main and jointed to the sanitary sewer pipe with a manufactured adapter specifically for such jointing shall be installed. It shall include rubber

gasketed fittings with stainless steel tightening bands. The joints shall be enclosed in a reinforced concrete collar at least 6 inches thick and extending at least 6 inches either side of the joint.

- (i) PVC pipe may be used if placed in a steel or ductile iron pipe casing or sleeve at least 20 feet in length, centered over the water main.
 - (b) Where the sewer is beneath the water main but less than 18 inches clear distance vertically, the sewer pipe of any material shall be encased in a steel or ductile iron pipe casing or sleeve. The casing pipe shall extend a distance of 10 feet on either side of the water main crossing.
 - (c) The above-described protection from potential cross connections shall apply to service lines as well as sanitary sewer mains where the above-described protection and special installation is required.
 - (d) There shall be no physical connection between a public or private potable water supply system and a wastewater pipeline or appurtenance thereto which would permit the passage of any sewage or polluted water into the potable supply.
 - (e) While no general statement can be made to cover all conditions, it is generally recognized that sewers must be kept remote from public water supply wells or other water supply sources and structures in accordance with the applicable Health Department Standards.
- b. Sanitary sewer service pipelines shall be located no less than 10-feet horizontally, edge of pipe to edge of pipe, from water service pipelines within public right-of-way or easements, regardless of vertical separation.

2.11 Stream and Drainage Channel Crossings

- a. All stream and drainage channel crossings shall be specified wastewater pipeline water encased in a steel or ductile iron casing pipe where the installation is below the flow line of the stream or drainage channel.
- b. Crossings less than 4 feet below existing or proposed channel bottoms shall be supported by reinforced concrete caissons constructed in accordance with the approved special design. Crossings of stream channels which cannot be demonstrated to be stable and not subject to any degradation shall be constructed with reinforced concrete caissons regardless of depth below existing stream channel flow line.
- c. Where the pipeline crossing will be above the stream or drainage channel flow line, special approval and design will be required by the District. All details of the design shall be submitted to the District for review and approval.

2.12 Railroad, Highway and Street Crossings

- a. All work shall be accomplished in accordance with the appropriate permit issued by the responsible agency having jurisdiction over the work.
- b. Crossings under railroads, highways, and certain specified streets shall consist of polyvinyl chloride (PVC), higher density polyethylene (HDPE), ductile iron or epoxy coated steel pipe (carrier pipe) laid inside a steel or ductile iron pipe conduit (casing pipe), which is placed beneath the track or roadway.
 - (1) The steel conduit pipe (casing pipe) shall be jacked horizontally through the ground on the grade of the sewer, with due allowance for the bells or joints of the carrier pipe.
 - (2) As the pipe is jacked along, the earth shall be excavated from the face and removed so that it will not be necessary to force the pipe through solid ground.
 - (3) Specifications for materials and installation of the railroad or highway agency shall govern.
- c. The District reserves the right to require a casing pipe be placed when crossing under a county, town, or city street.
- d. The casing pipe diameter for 16-inch and smaller carrier pipes shall be a minimum of 8 inches larger than the carrier pipe and the casing pipe diameter for larger than 16-inch diameter carrier pipe shall be a minimum of 12 inches larger than the carrier pipe.
 - (1) The District may permit alteration of this design criterion when HDPE pipe is used for the carrier pipe.
- e. After the casing conduit has been completed, the carrier pipe shall be placed inside and supported in exact position and grade with a support at intervals specified in the accepted construction details and behind each bell or coupling. A minimum of three points of support shall be installed to prevent displacement by floating.
- f. Each end of the casing pipe shall be enclosed tight around the carrier pipe and the casing pipe. The closure shall consist of a prefabricated rubber boot with stainless steel tightening bands specifically for sealing casing pipe ends.

2.13 Service Lines (Building Sewers)

- a. Service lines and stub outs from main sewers shall be extended to each property at a point no less than 10-feet inside the property line and generally 15-feet horizontally away from the low lot corner with a maximum invert depth of 12-feet inside the property line.
- b. Stub outs from a sewer main may be made to an unoccupied lot provided it is part of an officially platted and recorded subdivision.
 - (1) Stubs shall be extended to 15 feet inside property line and plugged with a watertight, and airtight glue cap fitting. Capping shall be sufficient to perform air

testing of the pipeline. Records of the depth and location of the end of the service stub shall be recorded by the party responsible for construction and submitted to the District for future reference.

- c. Residential Lots - 4-inch diameter green SDR-35 service lines shall have a maximum length of 250 feet.
- d. Service line connection to public wastewater pipelines or mains shall be accomplished with an in-line, factory-fabricated wye fitting with gasketed bell joints on the upstream extent of the wye branch and run. Spigot end or gasketed bell end may be used on the downstream end of the wye fitting.
- e. Connection of service lines to existing wastewater pipelines or mains installed with materials other than PVC shall use tee saddle fittings specifically manufactured for the pipe materials used.
- f. A two-way cleanout shall be installed on ALL private residential and commercial sewer service lines. Cleanout shall be located outside building foundation. The cleanout diameter shall match the diameter of the service line.
- g. Additionally, a two-way cleanout shall be installed on the service lines where the total length exceeds 1,000-feet and at 200-foot intervals for both 4-inch and 6-inch diameter service lines. A cleanout shall be installed on private sewer services at all changes in direction requiring bends exceeding 22 ½ degrees.
 - (1) Cleanouts shall have a proper waterproof cap.
 - (2) For cleanout access, a prefabricated formed wye with a riser pipe shall be installed to the finished grade.
 - (3) A double cleanout with a single stack is allowed.
 - (4) A minimum of 10-inch-long cast iron riser box with "SEWER" cast in the lid shall be placed over the cleanout access, flush with finished grade.
 - (a) Required for all cleanouts on commercial property.
 - (b) Required for all cleanouts placed in areas subject to traffic loading.
- h. Service lines projected to be longer than 250 feet in length shall have pipe 6 inches in diameter or as otherwise required by the District. Provisions for cleanouts shall also apply to pipelines 6 inches in diameter.
- i. No service line within the District's service area will serve more than one property or customer. Each house, building or business shall have an individual connection to the sewer main and service line from the main to the structure served.
- j. All service lines for commercial buildings or multi-family buildings shall be no less than 6 inches in diameter.

- k. Service line repairs – Schedule 40 pipe may be used in repairs for all pipe types that not SDR-35. New construction must still use SDR-35.
- l. Connections between clay pipe and PVC must have a Fernco coupling, with clamp screws up, wrapped in heavy plastic, with concrete added below connection.

2.14 Encasement and Casings.

- a. General: Concrete encasements shall be installed under the following conditions.
 - (1) Where sewer lines are at a depth too shallow to sustain traffic load or any other load to which they are subjected. The depth may range from 0 to 3 feet, depending on the loading conditions.
 - (a) A concrete cap or arch may be used in lieu of complete encasement when approved by the District Manager.
 - (2) At locations where infiltration is likely to be high.
 - (3) At locations where horizontal movement of the sewer mains may be experienced, such as in stream beds with less than 5-feet of cover.
 - (4) At potable water supply crossings where it is inappropriate to use pipe casings.
 - (5) At any location designated by the District Manager and/or Engineer.
- b. Design Considerations
 - (1) All concrete encasements shall be reinforced in accordance with the District's standard details and shall be of a length to completely span the condition encountered.
 - (2) Unless so designed, encasements are for the purpose of pipeline protection and are not to be considered a structural beam. Therefore, special attention to a good foundation and compaction effort for the encasement must be provided.
- c. Pipe Casings
 - (1) Pipe casing shall be used where required under road or railroad rights-of-way by the governing agency. All pipe casings shall be constructed to conform with the District's standard details, the Colorado Department of Transportation Standards, and the requirements of any other applicable approving agency.
 - (2) Pipe casing shall be used where minimum vertical clearances from potable water pipelines cannot be attained. Refer to other criteria established in these Regulations and criteria.

2.15 Pump Station Design Parameters.

- a. Design of pump stations within the District's collection system shall be accomplished on a case-by-case basis. Pump stations shall not be used wherever gravity sewer service is available. Preliminary considerations and a rationale for the need of the pump station shall be reviewed in detail with the District Manager prior to proceeding with preliminary and final design. As general guidelines for planning purposes, any pump station considered by the District must include, but is not necessarily limited to the following design features:
 - (1) Dry pit or wet well submersible pumping equipment.
 - (2) Multiple pumps.
 - (3) Standby power generation.
 - (4) Ventilation, heating and dehumidification equipment.
 - (5) Automatic controls.
 - (6) Remote alarm system for operating functions integrated with the District's I & C or SCADA system.
 - (7) Emergency overflow storage
 - (8). Other features and details of design, construction and operation as specified by adopted guidelines, criteria and policy.

2.16 Owner/Developer Costs

- a. Plans and Specifications. All costs associated with the design of sanitary sewer mains and services in accordance with District Rules and Regulations for undeveloped property shall be at the expense of the Owner/Developer.
- b. Construction. All costs associated with the furnishing and installation of wastewater pipelines and services in accordance with District Rules and Regulations shall be at the expense of the Owner/Developer.
- c. Plan Review and Construction Administration. The Owner/Developer of property shall pay all District costs including administrative, legal, and engineering fees in regard to plan review, preconstruction and construction progress meetings, field inspections, installation compliance, punch list preparation and all other construction expenses related to the development of the property.
 - (1) The Owner/Developer must execute a Connection Agreement with the District to initiate the Plan Review and Construction Administration process.
 - (2) A monetary deposit to secure payment of costs incurred by the District in the above activities shall be made by the Owner/Developer prior to any work or action being taken by the District in accordance with the Connection Agreement.

- (3) The amount and form of monetary deposit shall be as established by Resolution of the Board of Directors.

2.17 Sanitary Sewerage Plan Submittal Requirements

a. Plans and Specifications.

- (1) One (1) copy of preliminary plans and other documents shall be provided to the District for review, comment and record.
- (2) Upon submittal of plans and other documents suitable for final approval, the following must be provided:
 - (a) One (1) copy of all plans and specifications for facilities to be installed under these rules and regulations shall be furnished to the District.
 - (b) AutoCad files of the final approved plan set in .dwg format.
 - (c) One set of the final approved plan set, the final plat and Utility Service Plan in Portable Document Format (PDF) files.

b. Plan Content. As a minimum, the following information shall be required on all plans.

(1) Plan View

- (a) Streets, rights-of-way and utility easements
- (b) Location and size of the sewers
- (c) Locations and distance between manholes
- (d) Pipe slope
- (e) Other wastewater pipeline appurtenances
- (f) Size and location of service stubs
- (g) Location of all existing or proposed underground utilities and structures located within 30 feet horizontally or vertically of the centerline of the proposed sewer extension.
- (h) The scale is optional; however, H:1"=30' & V:1"=5' is commonly used.

(2) Profile View

- (a) Vertical and horizontal grids shall show the existing ground surface (dotted) and proposed surface (solid).
- (b) Proposed sewer with elevations of manhole rims and pipes at the manhole

- (c) Distance and pipe slope between manholes and elevations of utility crossings.
 - (d) All underground infrastructure crossing or in proximity to the proposed wastewater pipeline
- (3) Detail drawings: Special detail drawings, made to scale, shall clearly show the nature of design and construction of the following:
 - (a) Special wastewater collection system appurtenances such as non-standard manholes and elevated sewers.
 - (b) Special joints and utility or storm sewer crossings.
 - (c) Stream and drainage channel crossings with elevations of normal high and low water levels.
- c. Supporting Data. Submit with the plans and specifications all necessary supporting data to fully describe the proposed installation. This data shall include but not necessarily be limited to the following.
 - (1) A copy of the recorded plat of the subdivision in which the improvements are proposed to be installed.
 - (2) Copies of dedicated and recorded rights-of-way and easements in which improvements are proposed to be installed.
 - (3) Copies of necessary permits from other governmental or private agencies having jurisdiction in the area of the proposed work.
 - (4) Should a site application for a collection system extension be required by the Colorado Department of Public Health and Environment, the individual party responsible for construction of the facility shall also be responsible for obtaining this site approval with prior review and approval of the District.
- d. As-Constructed Data. Upon completion of construction and prior to acceptance by the District, "as-constructed" plans and other pertinent documents to include a copy of the field markups or "redline" construction documents shall be submitted to the District for record.
 - (1) One (1) copy shall be complete with all "as-constructed" information
 - (a) Provide a certification by the party responsible for construction that all data thereon is accurate and represents actual "as-constructed" conditions.
 - (b) As-constructed documents shall include all plans showing all public and private infrastructure in the development or otherwise appurtenant to the property served by the wastewater pipeline.
 - (2) "As-constructed" plans shall be submitted within two weeks of completion of the

sanitary sewer construction in any identifiable phase of a development.

- (a) No authorization to connect to the system or discharge to the system will be allowed until the "as-constructed" documents have been received and accepted by the District.
- (3) An electronic file or files of all "As-constructed" record documents and drawings shall be provided to the District.
- (a) All drawings shall be in a Civil3D 2019 or newer format.
 - (b) All documents shall have horizontal and vertical coordinate systems conforming to the District's standards for its geographical information system (GIS).
 - (i) Vertical Datum: NAVD 1988
 - (ii) Horizontal Datum: NAD 1983, Colorado State Plane coordinate system, Central zone, ground coordinates, using a combination factor specified by the District.
- e. All plans, specifications and supporting documents including as-constructed documents shall be prepared by or under the direct supervision of a professional engineer licensed to practice in the State of Colorado. All plans and specifications shall bear the seal and signature of said licensed professional engineer.

2.18 Sewage System and Trench and Foundation Drains

- a. In no case shall any trench drains, foundation drain, or other drainage fixture be connected to the District's system which may introduce any wastewater other than sanitary sewage into the system.
- b. All piping material incorporated into the District's sanitary sewage system shall not be white. At the time of the preparation of these specifications, the predominant pipe color is green.
- c. All trench or foundation drainage piping shall be white to preclude accidental cross-connection of the drainage systems.
- d. All foundation drainage laterals connecting to an underdrain near or within the sanitary sewer trench shall be three (3) inches in diameter.

ARTICLE III

PIPE AND MANHOLE MATERIALS

3.01 PVC Pipe and Fittings (Polyvinyl Chloride)

a. Conformance

(1) ASTM D3034; Standard Dimension Ratio (SDR) shall be maximum of 35.

b. Joints

(1) ASTM D3212; Bell and spigot, push-on with single rubber gasket.

(2) Jointing of dissimilar pipe materials shall be accomplished with a specially manufactured rubber connection with stainless steel tightening bands (Mission Rubber Company, Fernco or Ford Meter Box Co.).

c. Length of Joints

(1) The length of pipe joints for flexible conduits shall not exceed 14 feet for pipe slopes less than one percent.

d. Color

(1) **All sanitary sewage piping material shall be Green in color.**

e. Criteria for Acceptance. Pipe which has any of the following visual defects will not be accepted.

(1) Improperly formed pipe such that pipe intended to be straight has an ordinate, measured from the concave side of the pipe exceeding 1/16 inch per foot of length.

(2) Pipe which is out-of-round to prohibit proper jointing.

(3) Improperly formed bell and spigot ends or bells which are less than 1-1/2 inches in length.

(4) Pipe which is fractured, cracked, chipped or damaged in any manner.

(5) Pipe that has been damaged during shipment or handling.

(6) Pipe or fittings not properly marked as required by the following specifications.

(6) Pipe or gaskets which show obvious evidence of exposure to sunlight by fading.

f. Marking of Material. The following shall be clearly shown on the exterior of the pipe:

- (1) Manufacturer's name.
- (2) ASTM designation.
- (3) SDR.
- (4) Homemark.

g. Material Handling and Storage.

- (1) Avoid damage to pipe from impact, bending, compression or abrasion during handling and storage.
- (2) Store pipe on flat surface which provides even support for the pipe barrel with bell end overhanging.
- (3) Do not stack pipe higher than 5 feet.
- (4) Do not store pipe and fittings in direct sunlight for extended periods (greater than three weeks). Any discoloration of the pipe material shall be evidence of ultraviolet damage and shall be reason for rejection and removal from the project.
- (5) Ship rubber gaskets in cartons and store them in a clean area away from grease, oil, ozone producing electric motors, heat and the direct rays of the sun.
- (6) Use only nylon protected sling to handle pipe. The use of hooks, bare cables or chains will not be permitted.
- (7) Shop submittals for pipe material to be incorporated into the project must include date of manufacture for all pipes.

h. Trench and foundation drain piping used in the District shall be white in color to better assure that there is no accidental connection between the two separate drainage systems.

i. PVC pipe shall not be installed at depths in excess of sixteen (16) feet without specific approval of the District and design of appropriate pipe material, bedding and installation.

- (1) SDR35 may be installed when depths are 5 feet to 16 feet of earth cover.
- (2) SDR26 may be installed with 25 feet or less of earth cover.

3.02 Ductile Iron Pipe

a. Conformance

- (1) ANSI 21.51/AWWA C151; ASTM A536, Grade 60-42-10; Thickness Class 50 or Pressure Class 350, unless otherwise required for internal or external loading.
 - (2) Fittings shall conform to ANSI 21.10 for flanged, mechanical joints and push-on joints, AWWA C110 or C153.
- b. Joints
- (1) Mechanical Joint: ANSI A21.11
 - (2) Push-On: ANSI A21.11
 - (3) Flanged: ANSI B16.1, 125 lb. drilling
 - (4) Rubber Gaskets: AWWA C111 (ANSI A21.11)
- c. Protective Coatings and Linings
- (1) Exterior Coating: Manufacturer's standard bituminous coating approximately 1 mil thick.
 - (2) Interior Lining:
 - (a) Type: Ceramic Epoxy
 - (b) Thickness: 40 mils DFT
 - (c) Design Basis: U.S. Pipe Protecto 401™ or equivalent
- d. Polyethylene Wrapping. All ductile iron pipes shall be installed with an 8-mil thick polyethylene wrapping.
- (1) Conform to AWWA C105 latest revision.
- e. Criteria for Acceptance. In addition to any deficiencies covered by the reference specifications above, any of the following visual defects will not be accepted.
- (1) Improperly formed pipe such that pipe intended to be straight has an ordinate, measured from the concave side of the pipe exceeding 1/16 inch per foot of length.
 - (2) Pipe which is out-of-round to prohibit proper jointing.
 - (3) Pipe which is fractured, cracked, chipped or damaged in any manner.
 - (4) Pipe that has been damaged during shipment or handling.
 - (5) Pipe which has lining which is fractured, cracked, chipped or damaged in any manner and would not provide satisfactory service under the conditions intended.

d. Barrel Joints

- (1) Rubber gasketed joints for pre-cast manhole sections shall be an R-4 joint and designed in accordance with ASTM C443.
- (2) Manhole joints shall be joined with flexible plastic/rubber gaskets constructed of Ram-Nek, Rubber-Nek, Con-Seal or equivalent. Each segment shall be full bed and double wrapped.
- (3) Exterior joints shall be double wrapped with 12" wide elastomeric joint wrap completely adhered to the exterior of the manhole.
 - (a) Refer to watertightness material specification

3.04 Cast-In-Place Concrete.

- a. All cast in place concrete utilized in wastewater pipeline construction shall have a minimum compressive strength of 3000 psi at 28 days unless specifically required otherwise by the project.
- b. Aggregates
 - (1) Conform to ASTM C33, maximum size shall be 3/4-inch nominal diameter.
- c. Cement
 - (1) Portland Cement in accordance with ASTM C150, Type II or IILA will be used for all concrete.
- d. Admixtures
 - (1) Air entraining admixtures will be permitted in conformance with ASTM C260.
 - (2) Maximum entrained air shall be 6.5% and minimum shall be 5.0%.
 - (3) Water reducing and retarding admixtures may be utilized with the specific approval of the District. Such admixtures shall be in conformance with ASTM C493.
 - (4) Fly ash or calcium chloride are not permitted for use.
- e. Water/Cement Ratio
 - (1) Maximum water cement ratio shall be 0.42.
- f. Slump
 - (1) 1" minimum, 3" maximum for all concrete to be incorporated in sanitary sewerage facilities.

3.05 Castings

a. Cast Iron

- (1) Conformance: ASTM A48
- (2) Applicable Items: Manhole rings and covers with non-slip surface with "SEWER" or "FSD" cast in the cover. Combined weight will not be less than 290 pounds. The ring shall be a minimum of 4 inches in height and 24" minimum diameter clear opening.
- (3) Manhole covers shall provide for a lift hole, 1/2-inch in diameter located approximately midway between the center and edge of the cover. Notches at the edge of the cover are not acceptable.

3.06 Steps

- a. **All manholes shall NOT have steps installed.**

3.07 Cement Mortar

- a. Conformance: ASTM A270, Type M.

3.08 Cement Grout

a. Cement

- (1) Portland Cement in accordance with ASTM C150, Type II or II LA

b. Sand

- (1) Clean, well-graded, natural sand in accordance with ASTM C33

c. Proportioning

- (1) One part Portland Cement, 2½ parts sand, by weight, with minimum water required for placement and hydration

3.09 Non-Shrink Grout.

- a. Approved commercial factory mix product made especially for intended use. Utilize non-metallic chemical grout for non-shrink applications.

- (1) Sika

3.10 Waterproofing Material

- a. ICS Devoe "Devtar 5A"

- b. External concrete joint wrap; elastomeric protective film wrap; Henry Company Sealants Division, "RUB'R-NEK® External Concrete Joint Wrap".

ARTICLE IV

PIPE INSTALLATION

4.01 Subgrade Preparation

- a. See Part C, Earthwork Standard Specifications of these regulations.

4.02 General Requirements

- a. A pre-construction meeting must be arranged by the contractor and/or the developer's representative and held prior to the start of any work. The District representatives and/or District Engineer, Contractor, and Owner or Owner's Engineer must be represented at this meeting, which shall be held at the office of the District.
- b. All contractors must notify the District at least 48 hours prior to the start of construction.
- c. Approved plans and a copy of these specifications must be kept on the job site by the contractor at all times.

4.03 Pipe Laying

- a. Prior to the start of any work where sewer mains to be installed connect to existing District sewer systems, the nearest downstream manhole to the point of tie-in shall be plugged with a plumber's plug on the outlet side by the contractor.
 - (1) This plug shall remain in place until final acceptance by the District. Its purpose is to prevent any mud, water, or other materials from entering the existing line during construction.
 - (2) The contractor shall be responsible for pumping and cleaning these manholes and removing the plug when so instructed by the District Manager.
- b. Begin pipe laying at the lowest point, unless directed otherwise by the District, and install the pipe with the spigot ends pointing in the direction of flow.
- c. Unless required or directed otherwise by the District, lay all pipe straight between changes in alignment and at uniform slope between changes in grade or slope.
- d. As each length of pipe is placed in the trench, the joint shall be completed in accordance with the pipe manufacturer's recommendations and the pipe shall be brought to the correct line and elevation. The offset at the invert shall be less than 1% of the inside pipe diameter.
- e. If approved, the length of joints for curvilinear sewer shall be determined by the radius using joint deflection or radius of curvature not exceeding the manufacturer's recommendations, 3-degree couplings with an integral rubber gasketed bell, or a combination of both.

- (1) Refer to the approved plans for location of required 3-degree bends.
- f. Secure the pipe in place with Class B bedding material tamped under and around the pipe. Refer to bedding and backfill requirement for thickness of bedding layers.
- g. Do not walk on small diameter conduit or otherwise disturb any conduit after jointing has been completed.
- h. All foreign matter or soil shall be removed from the inside of the pipe before it is lowered into its position in the trench and shall be kept clean at all times during and after laying.
- i. All openings along the line of the sewer shall be securely closed and during suspension of work at any time, suitable pipe plugs or closures shall be placed to prevent water, soil or other materials from entering the pipeline.

4.04 Fittings, Couplings, Wyes and Saddles

- a. Fittings, couplings, wyes and saddles shall be the same material as the pipeline or as specifically manufactured for a particular installation.
- b. Jointing of dissimilar materials shall be permitted only with approval of the District representative.
 - (1) Jointing of such dissimilar materials shall be through the use of fittings, couplings, wyes, saddles, adapters or adhesives specifically manufactured for such transitions.

4.05 Service Lines

- a. Prepare subgrade in accordance with Part C of these regulations.
- b. Installation of any and all service lines whether from the main line to the property line or from property line to the building, must be inspected by the District, who shall be notified by the contractor at least 24 hours prior to installation.
- c. The type of service line connection fitting to be utilized when connecting to an existing main line shall be at the discretion of the District.
- d. Service line connections in new mains shall be constructed with an in-line wye fitting with the branch oriented in the top one-half of the sewer main.
 - (1) Connections made in the lower half or at mid-point of the main shall have prior approval of the District and may require the installation of a backflow prevention device on the service line.
- e. Connection of service lines to existing mains with installed materials other than PVC
 - (1) Tee saddles with rubber gaskets to be placed between the saddle and the main

line of pipe, secured in place with stainless steel bands are required when a new connection to an existing main with installed materials other than PVC is required.

- (2) Connection to the main line piping with a tee shall be made by cutting a hole using the appropriate hole template, tapping machine or hole saw no more than ¼-inch larger in diameter than the template outline.
 - (3) A 45° or 22-1/2° bend shall be used from the tee fitting to attain the desired elevation and slope for the service line piping.
 - (4) The tee saddle shall be furnished with an integral rubber gasketed bell.
 - (5) A two-way service line cleanout shall be installed outside of the building foundation. Each cleanout shall be constructed with sweep oriented downstream.
 - (6) All service lines will be connected.
- f. All service line piping between the main line and the property line of the property to be serviced shall be pipe in accordance with these specifications with integral rubber gasketed push-on joints and shall be connected to the building sanitary piping 5-feet from the building foundation at the cleanout located outside the building.
- (1) In general, no change in horizontal alignment will be permitted between the connection at the main line and the property line of the property being serviced.
- g. Service line connections shall be separated by a minimum of 3 feet measured center to center along the main.
- h. Plug all service line stubs with watertight and airtight glue cap fitting unless the service line will be immediately connected to a building sewer.
- i. Where new street construction is proposed immediately following construction of sanitary sewer facilities, extend the service line to 15 feet inside the property line, install the appropriate plug and mark with a vertical wood marker extending above the surface and having dimensions of 2" x 4" minimum. All sanitary sewer service pipelines shall be installed at a maximum of 12-feet in depth.
- j. Conform to the installation requirements for sewer mains for the installation of sewer service lines in the public right-of-way or easement. Class B bedding shall be required.
- k. Record the horizontal position/location of the sewer service and at the time curb and gutter is constructed and provide for the letter "S" to be pressed into the concrete at the curb head directly over the sewer service pipe.
- 1) The pressed "S" shall be a minimum 3" high x 2" wide and ¼" deep. All other methods must be preapproved by the District and in all cases must represent the letter "S". In general, all manually scribed methods will be unacceptable.
- l. The Contractor and/or Developer shall provide complete as-constructed information on each service line connection installed. As a minimum this information shall include the

following:

- (1) Location of the connection to the main referenced to the nearest manhole or other permanent improvement
 - (2) The location of the end of the service line stub
 - (3) The direction of the service line as it relates to surrounding permanent surface improvements
 - (4) Size/pipe diameter
 - (5) The material of construction
 - (6) Date and name of the installer
 - (7) All such information shall be provided to the District's representatives for incorporation into the District's permanent records.
- m. Connection of service lines and service line construction shall be accomplished by experienced, qualified personnel with adequate equipment. The District's representative shall have authority to reject work and may not permit work to be accomplished unless done by qualified personnel with suitable tools and equipment.
- n. Inspection by the District representative shall be required of each service connection prior to commencing any backfill.

4.06 Manholes

- a. Precast concrete manhole base
- (1) Precast flat slab base with integral precast barrel section.
 - (a) Conform to all requirements of ASTM C478, the District's standard specification and any project specific specification and details accepted by the District for a particular installation
 - (b) Flat slab bases shall have the same minimum thicknesses and reinforcing requirements as specified for cast-in-place concrete manhole bases.
 - (2) Where preformed rubber "boots" such as Kor-N-Seal boots are used in precast manhole bases, manhole gaskets on the pipe are not required.
- b. Cast-in-place concrete manhole base
- (1) Cast-in-place manhole base construction shall be permitted only with specific plan review and acceptance by the District. In general, precast manhole bases will always be used in the District.
 - (2) Prepare the subgrade and excavation in accordance with the specifications.

- (3) The pipes entering the base shall be cut to length to match the inside of the manhole barrel and set to grade. Sewer pipe shall not be laid through the manhole base and the concrete base and/or invert placed around the pipe unless project specific specification and details have been accepted by the District for a particular installation.
- (4) Manhole gaskets shall be placed over the pipe and centered between the end of the pipe and the outside of the cast-in-place base.
- (5) For manholes 16-feet or less in depth, provide reinforcing, grade 60 reinforcing bar, No. 4 at 12 inches on center each way. Place steel at 8-inches on center each way on manholes in excess of 12 feet in depth.
- (6) For manholes deeper than 16-feet, provide reinforcing, grade 60 reinforcing bar, No. 6 at 12-inches on center each way, two (2) layers placed 3-inches above subgrade and 3-inches below the manhole channel flow line.
- (7) Where intersecting pipelines or pipelines requiring deflections at manholes require that the invert of the manhole be shaped to match the pipe cross sections, such construction shall be accomplished in accordance with the detail drawings of these specifications. Form the flow line configuration of intersecting pipes to allow for free uninterrupted flow of sanitary sewage through and out of the manhole. All channel inverts shall be finished smooth by steel troweling. All inverts shall be placed and finished with a single pour of cast-in-place concrete. Placement of grout and/or other material to repair and/or reshape the manhole invert shall not be permitted unless specifically approved by the District's representative.
- (8) Cast-in-place bases for manholes shall be constructed in a manner to provide for a smooth level surface on which vertical barrel sections shall be placed. Completely watertight joints shall be made utilizing preformed flexible gasket material or a precast concrete base section may be utilized. The manhole shall be constructed such that no single section varies from true vertical by more than two percent of the section length.
- (9) Place concrete against undistributed soil to the depth, thickness and other dimensions shown on detailed drawings.
 - (a) 16-feet or less in depth: Minimum of 8-inches thick below the manhole channel flow line.
 - (b) Greater than 16-feet deep: Minimum of 12 inches thick below manhole channel flow line.
- (10) Finish and cure the cast-in-place concrete for a minimum period of 36-hours prior to placing precast manhole sections on the cast-in-place base.
- (11) Maintain ground water below the bottom of the cast-in-place concrete for a minimum period of 24 hours following placement of concrete by maintaining

pumping equipment or other dewatering operations in operation below the subgrade of the manhole base.

- (12) Concrete shall contain a minimum of 564 lbs of Type II Portland cement per cubic yard (6 sack mix), be placed with a maximum slump of 2 inches with maximum size coarse aggregate of ¾-inch (ASTM C33).
 - (13) Provide segmental precast concrete barrel sections a maximum of 4 feet in length with preformed flexible gasket material between each barrel section as jointing material or install rubber gaskets in precast R-4 joint grooves per manufacturer's recommendations.
- c. Provide waterproofing of all manhole joints.
- (1) Apply chemically cured high-build epoxy waterproofing to the precast manhole structure after installation of cement grout and prior to backfilling. During construction of all waterproofing measures, ground water shall be maintained below the subgrade elevation in the manhole excavation during the time sufficient for all materials to properly cure, no less than 24 hours.
 - (2) All exterior MH joints shall be double wrapped with 12" wide elastomeric joint wrap.
 - (a) Henry Company RUB'R NEK® External Concrete Joint Wrap or approved equal.
 - (3) Where ground water is present, or in the opinion of the district, ground water could be present, all exterior joints shall receive a 3/8" to 1/2" thick layer of cement grout extending a minimum of 4" each side of all manhole segment joints. Work the cement grout in the joint to completely fill all voids. Following installation of exterior joint grout, install a double wrap of 12" wide elastomeric exterior joint wrap, adhered to manhole.
- d. Provide one, one (1) foot high barrel section beneath a reducing concentric cone section to bring the manhole ring and cover to within 6 inches of desired grade and elevation.
- e. Ring and Cover Elevation Adjustment
- (1) Provide precast concrete 2-inch-high grade adjustment rings to bring the ring and cover to desired elevation.
 - (2) A minimum of one (1) 2-inch adjustment ring is required with a maximum of three (3) grade adjustment rings being permitted.
 - (3) The ring shall be adjusted with precast concrete rings a maximum of 6 inches in height. Cement grout shall be placed to adjust the ring to conform to the surface. A collar consisting of paving material shall be placed around the adjusting rings and the ring of the manhole up to a point 2 inches below finished grade.

Additional paving material shall then be placed over the concrete and match the surrounding pavement surface. Tack coat material shall be placed between new and existing asphaltic surfaces, the manhole casting and the concrete collar.

- (4) Plastic Rings: High Density Polyethylene material as found in ASTM Specification D-4976 may be used in place of precast concrete rings.
- f. All manholes constructed in the District shall have the ring and cover elevations set at final street grades or at a point not more than 6 inches above the existing ground in non-traffic areas unless directed otherwise by the District. The Developer/Contractor shall be responsible for adjusting the manhole rings and covers to the final elevations.
- g. In areas where street paving will be placed, the manhole ring adjustment shall be accomplished in a two-step process prior to placement of pavement. The manhole ring shall be constructed 0.3 to 0.5 feet below finished pavement surface elevation. Pavement shall then be placed in accordance with the applicable rules, regulations and specifications. Following completion of paving, the sanitary sewer manhole rings will be raised by the Developer/Contractor to finished grade in accordance with the specifications of the District.

ARTICLE V

TESTING OF PIPELINES AND APPURTENANCES

5.01 Infiltration.

- a. Each segment of pipeline including manholes or other major appurtenances shall not show any evidence of infiltration.
- b. Should evidence of infiltration be determined, repair and/or replacement of pipelines, manholes or other appurtenances shall be at the Contractor's and/or Developer's expense. Satisfactory repair and replacement shall be accomplished prior to the consideration of acceptance of any facility by the District.
 - (1) If deemed necessary by the District in its sole discretion, infiltration testing shall be accomplished near the end of the warranty period by the Contractor and/or the Developer.
 - (2) Final acceptance will be conditioned upon the required specifications being satisfied.
- c. The Contractor and/or Developer will furnish all labor, equipment and materials required to accomplish such testing.

5.02 Air Test.

- a. All segments of sanitary sewer mains shall be subjected to an air pressure test.
- b. The Contractor may conduct an initial air test of the sewer main line after compaction of the backfill but prior to the installation of any service lines. Such tests shall be considered for the Contractor's convenience in quality control of the project construction. Final consideration for acceptance of the sanitary sewer by the District shall be based on satisfactory completion of testing with all service line stubs installed.
- c. Preparation of Tests
 - (1) Flush and clean the sewer line prior to testing in order to wet the pipe surfaces and produce more consistent results.
 - (2) Plug and brace all openings in the main sewer line and the upper end of any connections.
 - (3) Check all pipe plugs with a soap solution to detect any air leakage. If leaks are found, release the air pressure, eliminate the leaks and start the test procedure over again.

d. Procedure of Test:

- (1) Add air until the internal pressure of the sewer line is raised to approximately 5.0 psi gage at which time the flow of air shall be reduced, and the pressure maintained between 4.5 and 5.0 psi gage for a sufficient time to allow the air temperature to come to equilibrium with the temperature of the pipe.
 - (2) Where ground water levels are above the conduit, increase the test pressures given below to compensate for the pressure on the conduit from the ground water.
- e. After the temperature has stabilized the pressure shall be permitted to drop to 4.5 psi gage at which time a stopwatch or a sweep secondhand watch shall be used to determine the time lapse required for the air pressure to drop to 4.0 psi gage.
- f. If the time lapse is less than that shown in the table, the Contractor shall make the necessary corrections to reduce the leakage to acceptable limits.
- g. If the time lapse exceeds that shown in the table, the pipe shall be presumed to be within acceptable limits for leakage.

Pipe Dia.(in.)	Minimum Time (min:sec)	Length For Minimum Time (ft.)	Time for Longer Length (L, ft.) (sec)	LENGTH (ft.)			
				100	200	300	400
4	1:53	597	0.190L	1:53	1:53	1:53	1:53
6	2:50	398	0.427L	2:50	2:50	2:50	2:51
8	3:47	298	0.760L	3:47	3:47	3:48	5:04
10	4:43	239	1.187L	4:43	4:43	5:56	7:54
12	5:40	199	1.709L	5:40	5:42	8:33	11:24
15	7:05	159	2.671L	7:05	8:54	13:21	17:48
18	8:30	133	3.846L	8:30	12:49	19:14	25:38
21	9:55	114	5.235L	9:55	17:27	26:11	34:54
24	11:20	99	6.837L	11:24	22:48	34:11	45:35
27	12:45	88	8.653L	14:25	28:51	43:16	57:42

Safety: The air test may be dangerous if proper precautions are not taken. All plugs must be sufficiently braced to prevent blowouts and the pipeline must be completely vented before attempting to remove the plugs.

As a safety precaution, pressurizing equipment shall be provided with a regulator setting of 5 psi to avoid over pressurizing and damaging an otherwise acceptable line.

5.03 Alignment Testing

- a. Each section of pipeline on a linear alignment between manholes will be subject to testing by lamping by the District's representatives to determine where proper

alignment has been accomplished and whether any displacement of the pipe has occurred during construction.

- b. The Contractor and/or Developer shall provide suitable assistance to the District's representative in accomplishing alignment testing. The Contractor and/or Developer shall be responsible for repairing any alignment, displaced pipe or other defects discovered during this testing in accordance with these specifications.
- c. For pipelines installed at grades less than 1%, a minimum of 90% of the full pipe cross section shall be visible at the opposite end of the segment being observed.
- d. For pipelines installed at grades greater than 1%, a minimum of 75% of the full pipe cross section at the opposite end of the segment shall be observed.
- e. The determination of the acceptability of the pipeline alignment by lamping shall rest solely with the District's representative and his decision shall be final.
- f. Pipelines not meeting the requirements of the alignment tests shall be completely excavated removed and re-laid on prepared bedding material, backfilled and compacted in accordance with these specifications and then subjected to infiltration, air pressure and alignment testing.

5.04 Deflection Tests

- a. Proper construction in accordance with these specifications and the manufacturer's recommendations should result in a vertical deflection of the pipe less than 5% of the internal diameter. At the option of the District, the Contractor and/or Developer may be required to perform testing to determine conformance with this requirement.
- b. Should the District determine that deflection testing is required, the Contractor and/or Developer shall provide all necessary equipment, labor and other facilities. Data supplied by the pipe manufacturer's representative for dimensional quality shall be utilized.
- c. Should the vertical deflection of the pipe be found to exceed 5% of the internal diameter, the Contractor will remove the pipe, install proper bedding, replace the pipeline material and properly place and compact all backfill material in accordance with these specifications. Any areas removed and replaced shall be subject to infiltration, air pressure and alignment testing.

5.05 Manhole Vacuum Test

- a. All manholes shall be subjected to a vacuum test prior to acceptance by the District.
- b. Manholes shall be vacuum tested using the following procedures:
 - 1) The Contractor and/or Developer shall provide all necessary equipment, labor and other facilities.

- 2) Temporarily plug all pipes entering the manhole.
- 3) The test head gauge shall be placed at the top of the manhole or in accordance with the manufacturer's recommendations.
- 4) A vacuum of 10-inches (5 psi) of mercury shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9-inches (4.5 psi) of mercury.
- 5) The manhole shall pass if the time for the vacuum reading to drop from 10-inches of mercury to 9-inches of mercury meets or exceeds the values indicated in the table below.
- 6) If the manhole fails the initial test, necessary repairs shall be made, and the manhole shall then be retested until a satisfactory test is obtained.
- 7) Minimum test times for various diameter manholes for depths 8-feet and greater (ASTM C1244).

Manhole Depth (ft)	Manhole Diameter (ft)	
	5	6
8	26	33
10	33	41
12	39	49
14	46	57
16	52	67
18	59	73
20	65	81
22	72	89
24	78	97
26	85	105
28	91	113
30	98	121
32	104	129
34	111	137
36	117	145
38	124	153
40	130	161

5.06 Internal Video Inspection

- a. All sewer main construction in the District shall be inspected with internal video camera and recording equipment.

- (1) Coordination with the District shall be required as to cleaning and/or flushing prior to any internal video inspection.
- b. All costs of the internal video inspection shall be borne by the Contractor and/or Developer.
- c. The individual and/or company and permanent video recording shall be subject to the acceptance and approval of the District.
- d. Internal video inspections shall be conducted for preliminary acceptance for sanitary sewer main lines, then again after all asphalt has been laid and ring and covers have been adjusted.