### 1. <u>Gravity Sewer Pipe</u>

Gravity sewer pipe shall be PVC SDR-35 or SDR-26 pipe furnished in twenty (20) foot minimum lengths. Pipe shall conform to ASTM Designation D-3034.

Gravity sewer pipe joints shall be gasket, push-on type such as "Ring-tite" or equal. Joint assembly shall be made according to the manufacturer's directions and shall comply with the guidelines for installation of PVC pipe as developed by the UniBall Plastic Pipe Association.

PVC SDR-35 pipe may be used for all gravity sewer installations where the depth of cover is less than 12'. For all gravity sewer installations where the depth cover is equal to or exceeds 12' PVC SDR-26 shall be used. All PVC gravity sewer pipe shall be installed as shown in the standard detail. Ductile iron pipe may be used for all gravity sewer installed per the standard detail.

### 2. <u>Sewage Force Main Pipe and Fittings</u>

Sewage force main pipe shall be either PVC-C900 or Ductile Iron Pipe as specified herein.

PVC force main pipe shall be SDR 14, 200 psi rated, conforming to AWWA C900 or C909 – pressure class 200, or Yellowmine as manufactured by Certainteed or Aquamine, as manufactured by John Boyle and Company, or equal.

Ductile Iron pipe shall be used where indicated, or used as an alternate selection in all other instances where either PVC or ductile iron pipe may be used. Ductile iron pipe and fittings shall be rated pressure Class 350 in accordance with AWWA C151, thickness Class 51 in accordance with AWWA C150 or equal. The pipe shall be cast in accordance with AWWA C 151. Cement lining in the ductile iron pipe shall have been prepared and placed in accordance with AWWA C104. Ductile iron pipe shall be delivered in minimal eighteen (18) foot or twenty (20) foot lengths. Joints shall be gasket, push-on types. All ductile iron pipe shall have an exterior coat of a bituminous material.

Fittings for either PVC or ductile iron pipe sewage force main shall be ductile iron. Fittings for PVC pressure pipe shall incorporate the proper or necessary adaptor or transition gasket. Ductile iron mechanical joint fittings shall be used for all buried pipe installations.

### 3. Pipe Restraint Systems

Pipe restraints may be used in lieu of or along with concrete restraint as specified on the plans. Acceptable pipe restraints shall be as follows:

- Pipe restraint systems used with ductile iron pipe shall be similar One Bolt, Mueller, AquaGrip, US Pipe Field 350 gasket or Megalug Series 1100 and 1200 as manufactured by EBAA or equal.
- Pipe restraint system used with specified PVC pipe shall be similar to One Bolt, Mueller AquaGrip, or Uni-flange Series 1500 "Circle-Lock" as manufactured by the Ford Meter Box Company, Inc. or similar; appropriately designed Megalug system by EBAA or equal system designed for use on PVC pipe.

### 4. <u>Marking Tape and Copper Wire Locator</u>

Marking tape shall be required on all pipe lines except sanitary sewer mains where manholes will be exposed at both ends of the pipe segment. Detectable mylar marking tape shall be similar to Lineguard, Inc. utility marking tape, Type II or equal. The tape shall bear the printed identification "Caution: Sewer Line Below". The printing shall be under mylar (reverse printed) so as to be readable through the clear mylar. Surface painting on the tape is not acceptable. The tape shall be "Safety Orange" in color and shall be one and one-half (1 ½) inches or two (2) inches in width. Marking tape colored green to comply with the color coding of the Underground Utilities Damage Prevention Act shall also be permitted. Marking tape shall be placed at the depths noted in the standard pipe backfill detail.

Note requirement in paragraph 8c herein which requires a copper locator wire for all PVC

# 5. <u>Manholes</u>

Precast manholes shall conform to ASTM C.478. Minimum inside diameter shall be forty-eight (48) inches with minimum of five-inch thick walls. Joints shall be the O-ring joint or tongue and groove type using butyl rubber conforming to ASTM C.443. Noncorrosive manhole steps shall be provided in manholes and shall be on sixteen-inch center maximum. All manholes shall have monolithic bases except when a new manhole is built on an existing line. The eccentric design manhole shall be used, unless otherwise approved. Provision for indicated pipe connections shall be made by means of an approved flexible, watertight gasket. Existing lines shall be grouted into place.

# 6. <u>Manhole Frames and Covers.</u>

Frames and covers shall be of cast iron conforming to ASTM A.48 for Class 30 Gray Iron. Covers shall not be buried. Watertight manhole frames and covers shall be used where necessary.

# 7. <u>Manhole and Pipeline Testing</u>

- a.) Generally. All sewer lines shall be tested by any or all of the following methods for both displaced or structural faults and for water tightness by the owner/contractor. The testing methods used shall be at the option of the General Contractor. The owner/contractor shall make all preparations and shall supply the labor for all tests. The owner/contractor shall supply specialized equipment, such as T.V. cameras, if necessary, for the conduct of such tests. Records of all test results shall be maintained by the owner.
- b.) Displacement testing Lights. A light will be flashed between manholes by means of a flashlight or by reflecting sunlight with a mirror. If the illuminated interior of the pipeline shows any deficiencies such as visible leaks, poor alignment, displaced pipe or any other defects, the deficiencies will be remedied by the owner/contractor at his expense.
- c.) Displacement and structural testing T.V. A T.V. camera may be used to locate defects in the pipeline. These defects shall then be remedied by the owner/contractor at his expense. T.V. inspection will only be required upon failure of the sewers to pass other tests and failure of the owner/contractor to make necessary repairs such that the pipe fails subsequent retests.
- d.) Deflection testing. Pipe may be measured for vertical ring deflection after completion of the backfill. Maximum ring deflection of the pipe under load shall be limited to five (5) percent of the vertical internal pipe diameter. Testing shall be accomplished by recording deflectometer or by approved mandrel, sphere, or pin type go/no-go device. Such equipment shall be furnished
- e.) Vacuum test. Vacuum testing of manhole construction may be used on precast concrete manholes only. Manholes should be tested after assembly and prior to backfilling and all stubouts, manhole boots and pipe plugs shall be secured to prevent movement during the test. Equipment utilized for vacuum testing shall be approved by the Virginia Department of Health, Department of Environmental Quality – Office of Wastewater Engineering or other applicable regulatory agency. A measured vacuum of ten (10) inches of mercury shall be established in the manhole. The time for the vacuum to drop to nine inches of mercury shall be recorded. This time is the leakage rate and the maximum allowable rate shall be as follows:

Minimum Elapsed Time for one Inch of Hg Pressure Change

Manhole Depth 4-feet Diameter 5-feet Diameter 6-feet Diameter 10 ft. or less 60 seconds 75 seconds 90 seconds > 10 ft. or < 15 feet 75 seconds 90 seconds 105 seconds > 15 ft. or < 25 ft. 120 seconds 90 seconds 105 seconds

f.) Water tightness testing – Infiltration. When in the opinion of the owner/contractor's engineer, the trench or excavation is sufficiently (four (4) feet above crown) saturated as a result of ground water or rain, tests may be made on the basis of infiltration. The contractor shall carefully measure the flow of water at the nearest downgrade manhole. The necessary supply of water, plugs, labor and equipment shall be furnished by the owner/contractor at his expense. Three (3) series of measurements shall be made at not less than one-hour intervals and the results shall be reduced to an average. This average shall then be computed so as to apply for the 24hour period. All such tests shall be made only under the supervision of the owner/contractor's engineer. The infiltration test shall be allowed only when it can be proven that the hydrostatic head outside the pipe is a minimum of four (4) feet above the pipe for the entire test length. All defective work shall be immediately repaired and retested until proven to be satisfactory. Infiltration shall not exceed a rate of one hundred (100) gallons per inch of pipe diameter per mile per day for any section of the system.

g.) Water tightness testing – Exfiltration. When conditions are not suitable for making infiltration tests, an exfiltration test may be made. The line to be tested shall be filled so that a head of at least four (4) feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than four (4) hours. After absorption, the head shall be re-established. The amount of water required to maintain this water level during a two-hour test period shall be measured. Exfiltration shall be determined by measuring the amount of water added to keep the upper manhole filled to a depth of four (4) feet above the barrel of the pipe. Three (3) series of measurements shall be made at not less than one hour intervals, and the results shall be reduced to an average exfiltration rate, and then applied to the 24-hour period. Manholes may be tested in a similar manner. Leakage measured by this test shall not exceed one hundred (100) gallons per inch diameter per mile of pipeline per day. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished.

h.) Water tightness testing – Air. The owner/contractor shall plug the pipe and shall conduct a low pressure air test to determine the acceptability of the completed work. The air testing equipment shall be Air-Lock, as manufactured by Cherne Industrial, Inc., or approved equal. All air used shall pass through a single control panel. Individual air hoses shall be used from the control panel to pneumatic plugs, from control panel to sealed line for introducing low pressure air, and from sealed line to control panel for continually monitoring the air pressure rise in the sealed line. The following procedure shall be followed for the air test.

### 1.) Clean pipe to be tested by propelling snug-fitting inflated rubber ball through the pipe with water if necessary.

### 2.) Plug all pipe outlets with suitable test plugs. Brace each plug securely.

- 3.) If the pipe to be tested is submerged in groundwater insert, a pipe probe by boring or jetting into the backfill material adjacent to the center of the pipe, and determine the pressure in the probe when air passes slowly through it. This is the back pressure due to groundwater submergence over the end of the probe. All gauge pressures in the test should be increased by this amount.
- 4.) Add air slowly to the portion of the pipe installation under test until the internal air pressure is raised to four (4.0) psig.
- 5.) After an internal pressure of four (4.0) psig is obtained, allow at least two (2) minutes for air pressure to stabilize, adding only the amount of air required to
- 6.) After stabilizing the internal pressure at four (4.0) psig, reduce the internal air pressure to three and one-half (3 ½) psig, and start stopwatch. Determine the time in seconds that is required for the internal air pressure to reach two and one-half
- 7.) The portion of sewer tested shall be deemed acceptable if the time required for the pressure to fall one pound is not less than that shown in the following table for the respective pipe sizes:

Pipe Dia. (Inches)	4	6	8	10	12	15	18	21	24
Time (Minutes)	2	3	4	5	5.5	7.5	8.5	10	11.5

8.) If air testing is employed, the manholes shall be tested by exfiltration not to exceed one-half gallon per hour.

NOTE: An air test of sewer line may be dangerous if a line is improperly prepared. It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. Inasmuch as a force of two hundred fifty (250) pounds is exerted on an eight-inch plug by an internal pipe pressure of five (5) psi, it should be realized that sudden expulsion of a poorly installed plug or of a plug that is partially deflated before the pipe pressure is released can be dangerous. As a safety precaution, pressurizing equipment should include a regulator set at perhaps ten (10) psi to avoid overpressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manhole during testing.

- (i) Manhole exfiltration testing. A separate exfiltration test shall be conducted on each manhole. Inlet and outlet lines shall be suitably plugged before starting the presoak period. After a presoak period of at least four (4) hours but not more than twelve (12), the manhole shall be filled to the top of the rim. The amount of water required to maintain this level during a two-hour test period shall be measured. A detectable leakage shall be cause for rejection and the leakage shall be corrected and retesting accomplished at the expense of the owner/contractor.
- (j) Manhole vacuum testing. When requested by the owner/contractor manholes may be tested by the vacuum method. Manholes shall be tested after assembly and prior to backfilling. Stubouts, manhole boots and pipe plugs shall be secured to prevent movement while the vacuum is drawn. Installation and operation of vacuum equipment and indicating devices shall be in accordance with equipment specifications for which performance information has been provided by the manufacturer and approved by the health department. A measured vacuum of ten (10) inches of mercury shall be established in the manhole. The time for the vacuum to drop to nine (9) inches of mercury shall be recorded. Acceptance standards for leakage shall be established from the elapsed time for a negative pressure change from ten (10) inches to nine (9) inches of mercury. The maximum allowable leakage rate for a four-foot diameter manhole shall be in accordance with the following:

Manhole Depth	Minimum Elapsed Time for a Pressure		
_	Change of one inch Hg		
10 ft. or less	60 seconds		
> 10 ft. but < 15 ft.	75 seconds		
> 15 ft. but < 25 ft.	90 seconds		

For manholes five (5) feet in diameter, add an additional fifteen (15) seconds and for manholes six (6) feet in diameter, add an additional thirty (30) seconds to the time requirements for four-foot diameter manholes. If the manhole fails the test, necessary repairs shall be made and the vacuum test and repair shall be repeated until the manhole passes the test or the manhole shall be tested in accordance with the standard exfiltration test and rated accordingly. If a manhole joint sealer is completely pulled out during the vacuum test, the manhole shall be disassembled and the sealer replaced.

(k) Water tightness testing – Force mains. The owner/contractor shall make all preparations, furnish all equipment, and shall supply the labor for all tests. Pressure and leakage tests shall be in accordance with AWWA C.600, Section 4. The test pressure shall be one hundred fifty (150) psi or one and one-half (1 ½) times the working pressure at the lowest point in the test section. The pressure and leakage tests shall be conducted concurrently for a duration of two (2) hours. The section of pipe under consideration shall be slowly filled with water and brought to the specified pressure by means of a pump. Before supplying the specified test pressure, all air shall be expelled from the pipe. Testing shall not begin until at least seven (7) days after the last concrete anchor has been poured on the section of line being tested (if high early concrete is used, two (2) days). Leakage shall be defined as the quantity of water that must be supplied into the pipe section to maintain pressure within five (5) psi of the specified test pressure.

The Owner/Contractor's Engineer or its designated representative shall observe all leakage tests. If the pipe fails to meet test requirements, all leaks shall be repaired and defective pipe repaired or replaced at the owner/contractor's expense. The test shall be repeated until satisfactory results are obtained.

Allowable Leakage per 1,000 feet (305 Meters) of Pipeline*												
	(Gallons per Hour)											
Ave. Test	Pipe Diameter (inches)											
Pressure												
(psi)	2	3	4	6	8	10	12	14	16	18	20	24
300	0.26	0.39	0.62	0.78	1.04	1.30	1.66	1.82	2.08	2.34	2.60	3.12
275	0.25	0.37	0.50	0.75	1.00	1.24	1.49	1.74	1.99	2.24	2.49	2.99
250	0.24	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.90	2.14	2.37	2.66
225	0.23	0.34	0.46	0.68	0.90	1.13	1.36	1.68	1.80	2.03	2.26	2.70
200	0.21	0.32	0.43	0.64	0.86	1.06	1.28	1.48	1.70	1.91	2.12	2.66
175	0.20	0.30	0.40	0.69	0.80	0.99	1.19	1.39	1.69	1.79	1.98	2.38
150	0.18	0.28	0.37	0.66	0.74	0.92	1.10	1.29	1.47	1.66	1.84	2.21
125	0.17	0.25	0.34	0.60	0.67	0.84	1.01	1.18	1.34	1.61	1.68	2.01
100	0.15	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.36	1.50	1.80
*If the pipeline under test contains sections of various diameters, the allowable leakage will be												
the sum of the computed leakage for each size.												
(Ord. Of 11	(Ord. Of 11-19-96, Ch. VII, § VII-1-)											

### 8. <u>Pipeline Backfilling</u>

(a) Materials. All backfill materials shall be free from mud, refuse, construction debris, organic material, boulders, stones over three-quarter inch, and frozen or otherwise unsuitable material. From one foot above the top of the pipe to the original ground elevation, however, material containing stones up to five (5) inches in their greatest dimension may be used, unless otherwise specified. The owner/contractor may backfill with the excavated material, provided it meets the conditions as stated above.

(b) Initial backfill. All trenches shall be backfilled with VDOT #10 or #26 crusher run aggregate in layers not exceeding four (4) inches from the bottom of the trench to the centerline of the pipe. Special care shall be taken to backfill under the pipe and to tamp this material into place to provide a firm bed. Material shall be deposited on both sides of the pipe simultaneously and compacted into place by tamping to a minimum ninety-five (95) percent standard Proctor density as measured by AASHTO Specification T-99. From the centerline of the pipe to a depth of one foot above the pipe, the trench shall be backfilled with approved material in six-inch layers and thoroughly compacted. Special care shall be taken to prevent damage to the pipe by backfilling and compaction equipment.

(c) Backfilling to grade. The remainder of backfilling shall be carried up in increments of one foot, except in VDOT rights-of-way where layers shall be no greater than six (6) inches thick. Minimum required density shall be the density of the adjacent undisturbed material except under pavement or in VDOT shoulders where backfill shall be compacted to a minimum of ninety-five (95) percent density when tested in accordance with AASHTO Specification T-99 (standard proctor). Each layer of earth shall be compacted into place by tamping before the next layer is applied. A hydro-hammer shall not be used. All pipelines shall have a minimum of eighteen (18) inches of cover before any rolling equipment is used. Damage to pipelines or other structures resulting from compaction shall be corrected by the owners/contractor.

A copper wire (size #14 or larger) shall be installed parallel to and at the same depth with all PVC force main pipe and looped around all valves. In addition, a Mylar marking tape of the appropriate color shall be installed over all PVC force main pipe. The marking tape shall be buried twelve (12) to eighteen (18) inches below the finished surface.

(d) Backfill testing. The owner/contractor shall demonstrate the adequacy of backfill compaction by performing density testing of the completed trench in non-controlled backfill areas as designated by the Owner's Engineer. Density testing shall be performed at three (3) depths for each test location: surface, mid-depth, add near maximum trench depth. In grass and lawn areas, the testing shall be performed at three (3) depths for each test location: under the topsoil backfill, mid-depth, and near maximum trench depth. The character of the backfill material will be observed during the excavation for density testing to determine conformance with the specifications. Density testing shall be performed using nuclear field density equipment or conventional weight-volume methods. If the weight-volume method is used, volume shall be determined by using the sand replacement test (ASTM D-1556) or liquid displacement methods (ASTM D-2167). If nuclear methods are used, the trench correction effect shall be accounted for by recalibrating the nuclear gage on its calibration block at the location of each test prior to taking the density measurement. The density of the backfill shall be equal to or greater than the density of the undisturbed material in the immediate area adjacent to area under test. The owner/contractor shall furnish all equipment, tools, and labor to conduct the testing.

Testing shall be performed by an independent testing laboratory qualified to perform such tests. All testing shall be witness by the Owner/Contractors' Engineer. The test shall be repeated until satisfactory results are obtained.

(e) Normal testing frequency. One test shall be performed within the first five hundred (500) feet of pipe installed by each crew. This test will be used as an initial evaluation of the compaction methods being used. Beyond the initial five hundred (500) feet, one test shall be performed in each 1,000-foot section of pipe installed. The location of the test within each 1,000foot section shall be selected by the county. Testing which indicates that unacceptable material has been incorporated into the backfill, or that insufficient compaction is being obtained, shall be followed by expanded testing to determine the limits of the unacceptable backfill.

### 9. Site Restoration

(a) Fill. Materials for fill areas shown on the plans shall be secured from excavation after rejection of any unsuitable materials. Rock or rocky material may be incorporated into fills if size and shape permit, if placed in lower portion of fills where the stability will not be affected, and if placed in such a manner that the perviousness will not be increased. Material shall be spread in layers with moisture controlled, and compacted to a minimum density of ninety-five (95) percent in accordance with AASHTO T-99 (standard proctor).

(b) Finished surfaces. Uniformly smooth grading of disturbed areas shall be required after backfill and compaction. Road shoulders shall have a minimum depth of six (6) inches of VDOT #25 or #26 crusher run aggregate, thoroughly compacted to a minimum ninety-five (95) percent standard Proctor density as measured by AASHTO Specification T-99. Ditches and gutters shall be finished to drain readily. In grass or lawn areas, the last four (4) inches of slightly compacted fill will consist of topsoil or an approved soil which will support a turf growth after fertilizing and seeding. Settlement or other damage that occurs prior to acceptance of this work shall be repaired and grades satisfactorily re-established. The owner/contractor will be responsible for and shall repair any settlement in the backfill for a period of one year after completion of the

(c) Backfill under pavement. Backfilling of trenches under pavement shall be in layers of selected earth not more than six (6) inches in thickness, and each layer shall be compacted to a minimum of ninety-five (95) percent density as compared to density of the same material when tested in accordance with AASHTO Specification T-99. The top course of backfill directly under pavement shall consist of aggregate base material meeting the requirements of VDOT #21 or #21A stone. The depth of this course shall be at least one and one-half (1 ½) times greater than the existing base course, but in no case shall be less than six (6) inches. This material shall be thoroughly and uniformly tamped with pneumatic tampers or other approved methods. Moisture content shall be within twenty (20) percent of optimum. The owner/contractor will be responsible for and shall repair any settlement in the backfill or pavement for a period of one year after completion of the work.

(d) Restoration of pavement, structures and other property. The owner/contractor shall restore all sidewalks, curbing, gutter, shrubbery, fences, poles, culvert, or other property and surface structures removed or disturbed as a part of the work to a condition equal to that before the work begun. Within the public right-of-way, the owner/contractor shall give the property owner two (2) weeks written notice to remove the shrubbery, trees, or other property, with the exception of fences, which will be affected by the construction. If such property has not been removed after sufficient notification, the owner/contractor may remove or take other measures as needed to proceed with the work. Fences shall be removed and replaced by the owner/contractor.

Property located within easements shall be considered the same as that within the public right-ofway unless shown otherwise on the plans, or unless specific instructions concerning such property are transmitted to the owner/contractor in writing. The owner/contractor may negotiate with a property owner to restore property to a condition other than that before the work began. Any agreements with property owners should be written and shall be made available to the

Pavement shall be repaired with a bituminous concrete, VDOT Type 5-5 at least one and onehalf (1 ½) times the thickness of the existing surface material but in no case less than two (2) inches. On VDOT roads, after placement of the bituminous concrete patch, a pavement seal shall be applied a minimum of five (5) feet on each side of the crossing. In cases of pavement cuts parallel to the road centerline, the entire width of road shall have a pavement seal applied after initial patching. Where required, pavement seal shall be performed in accordance with VDOT Specification 315. The following rates shall be required:

CRS-2	Bituminous Material	0.30 Gal/S.Y		
#78	Cover Stone	25 lbs/S.Y.		

(e) Cleanup. The owner/contractor shall at all times keep the job cleaned to the satisfaction of the property owner, owner/contractor or VDOT as appropriate. In all cases, he shall "broom" the surfaces of paved streets immediately following backfilling. All surplus materials shall be removed and disposed of from the site of the work unless otherwise directed by the owner/contractor. When material is placed on pavement, a layer of stone dust or sand shall be applied first to facilitate cleanup.

(f) Seeding. The seeding, fertilizing, and mulching of all lawn and grass areas disturbed shall be in accordance with these specifications and Section 604, "Seeding," of the current edition of the VDOT Road and Bridge Specifications and with Virginia's Erosion and Sediment Control Handbook, latest edition.

(g) Lime. Unless otherwise noted, agricultural ground or pulverized limestone shall be applied at the rate of two (2) tons per acre.

(h) Fertilizer. Areas to be seeded shall be fertilized with a 5-10-5 fertilizer at the rate of three thousand (3,000) pounds per acre. The fertilizer shall be worked into the soil by harrow or rake at least forty-eight (48) hours prior to seeding.

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