

III. TECHNICAL SPECIFICATIONS

DIVISION 10

STORM DRAIN PIPE & FLARED END SECTIONS

10.01 SCOPE: Storm drain pipe and flared end sections are to be furnished and installed in accordance with Section 302 of VDOT Road and Bridge Specifications with the following exception:

- A. The Contractor shall provide excavation, sheeting, backfill, bracing, joint sealant, erosion control filter material, dewatering equipment and operations, and other materials, labor, or equipment as needed to properly install the pipe in accordance with the Specifications and good construction practice, without any separate payment for such, to be inclusive and incidental to the price per lineal foot of pipe and the price per each for end sections. The Engineer may direct that the grade of pipe be adjusted up to 1.5' from the plan invert without any additional payment to the Contractor.
- B. In addition, pipe installation shall include connecting proposed storm drainage pipe to existing structures that are shown on the plans to remain in place. Such work shall be performed in reasonably close conformity with the alignment and invert shown on the construction plans.

10.02 MATERIALS: All pipe and end section materials unless otherwise explicitly provided on the plans shall be new and shall be furnished in accordance with the following requirements:

- A. Reinforced Concrete Pipe for Storm Drains and Flared End Sections:
 - 1. Shall conform to the requirements of ASTM Designation C-76 for Reinforced Concrete Culvert and Storm Drain Pipe.
 - 2. Shall conform to the sizes shown on the plans: All pipe for storm drains shall be reinforced concrete pipe; pipe in the street right-of-way shall be Class III; all others may be Class II unless indicated otherwise on the plans.
 - 3. The Contractor shall use a preformed flexible plastic sealing compound of Butyl Mastic Rope Sealer - 1" size, "EZ Stick" as manufactured by Concrete Products supply or an approved equal for sealing water-tight joints.
- B. Corrugated Steel Culvert Pipe, Pipe Arches, and End Sections: This Section is the same as Section 232.02 C-1, 2 of the Virginia Department of Transportation Road

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and Bridge Specifications with the following modifications and additions:

1. Helically corrugated steel pipe shall be lock seam or welded seam with minimum of two (2) annular corrugations rerolled into each end.
2. Connecting bands shall be standard corrugated bands or hugger type bands which shall engage at least one (1) annular corrugation for the periphery of the pipe on each side of the joint. Bands are to be asphalt coated in accordance with VDOT Road and Bridge Specifications, Section 232.02 C-1, 2, with a minimum 7" wide neoprene gasket. Corrugated bands shall not be less than 12" wide for pipes with diameters 36 inches to 84 inches inclusive. Dimple bands will not be permitted. Pipe shall be manufactured in accordance with VDOT Road and Bridge Specifications, Section 232.02 C-1, 2.
3. Aluminized Type 2 corrugated steel pipe shall be manufactured in accordance with AASHTO M-274-80 from a base metal manufactured in accordance with ASTM A-526 coated uniformly on both sides with 1.00 oz/sq.ft. of commercially pure aluminum. The pipe, band couplers and fittings shall conform to the requirements of AASHTO M-36. The pipe shall be fabricated with helical corrugations but shall have two annular rerolled corrugations. The pipe shall have a continuous welded seam, utilizing ultrahigh frequency resistance equipment or lockseam.
4. Aluminized Type 2 corrugated steel pipe may be provided with a concrete lining. The concrete shall be of such consistency as to produce a dense, homogenous lining. The nominal lining thickness shall be a minimum 1/8" over the inside crest of the corrugation. The concrete lining shall have a uniform thickness and a smooth surface and shall be manufactured per ASTM A-849 section 5.3.7. Handling or installation damage to the lining shall be repaired per ASTM A-849 9.1.2 and manufacturer's recommendations.
5. Pipe shall be fully asphalt coated (FC), full coated with paved invert (FCP) or full smooth-interior as required. Full smooth-interior pipe shall be fully coated and smooth lined on the inside of the pipe so that the corrugations are filled to a minimum thickness of 1/8" over the corrugations. The interior lining shall be applied centrifugally. Asphalt coating shall conform to VDOT Road and Bridge Specifications, Section 232.02 C-1, 2 for material and application.

C. Corrugated Aluminum Culvert Pipe, Pipe Arches and End Sections:

This section is the same as Section 232.02 of the VDOT Road and Bridge

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Specifications with the following additions:

1. Helically corrugated aluminum pipe and aluminum pipe arch shall be corrugated lock seam or welded seam. Corrugations shall be in accordance with the plans.
 2. No asphaltic coating or paved inverts shall be applied to corrugated aluminum pipe or corrugated aluminum pipe arches.
 3. Connecting bands shall be standard corrugated aluminum bands or hugger type bands which shall engage at least one (1) corrugation for the periphery of the pipe on each side of the joint with a minimum 7" wide neoprene gasket. Corrugated bands shall not be less than twelve (12) inches wide for pipes with diameter 36 inches to 84 inches inclusive. Dimple bands will not be permitted.
 4. Corrugated Aluminum Alloy Pipe shall conform to AASHTO Standard Specification M-196.
- D. PVC Storm Drainage Pipe: PVC storm drain pipe shall meet the following specifications.
1. Impact Resistance - ASTM D 2444, using 30 lb. TUP B and flat plate holder B the minimum impact strength shall not be less than 120 ft. lbs.
 2. Pipe Stiffness - ASTM D 2412, stiffness shall exceed 10 psi.
 3. Gaskets shall be ASTM F477. Only those gaskets and lubricants specified by the pipe manufacturer shall be used. Under no circumstances shall Vaseline or other petroleum products be substituted as an assembly lubricant.
 4. PVC pipe which exhibits discoloration from prolonged storage in direct sunlight may not be used as this may result in a reduction of the effective service life and material performance under loading.
- E. Polyethylene pipe (PE): Polyethylene pipe shall conform to requirements of AASHTO Designation M-252 and M-294.
- F. Connection to Existing Structure: Any reconstruction of the existing drainage structure required as a result of a connection from a proposed pipe must be with the same type of material used in the original construction and as per Volume II of the City's Public Facilities Manual.

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- G. Changes in pipe material can occur only at a structure and no more than one change in material shall be made on a continuous storm drainage system.
- H. pH and Soil Resistivity tests must be performed and approved prior to installation of corrugated metal or aluminum pipe if introduced by the Contractor as a material substitution and not previously included on the construction plans, with the Contractor paying all costs for said tests.
- I. All pipe joints, except PVC Storm Drainage Pipe, shall be wrapped with a nonwoven erosion control filter material in accordance with Division 30.03A.

10.03 EXECUTION:

- A. All pipe and end sections shall be laid true to line and grade proceeding upgrade with the spigot pointing in the direction of flow. The sections of the pipe shall be so laid and fitted together that, when complete, the pipeline will have a smooth and uniform invert, with the full length of the barrel resting on the trench bottom with holes excavated to accommodate pipe bells. The pipe shall be kept thoroughly clean. Each pipe shall be inspected for defects before being lowered into the trench. Water shall not be allowed to rise around the joint until it has been made tight. No more than two hundred (200) feet of trench shall be opened in advance of pipe laying unless permitted by the Engineer. The excavation of trenches shall be fully completed a sufficient distance in advance of the laying of the pipe. The interior of the pipe shall be carefully freed from all dirt or superfluous materials of every description as the work progresses. Pipe joints, except PVC, shall be completely surrounded by a strip of nonwoven erosion control filter material, centered on the joint, with overlap extending from spring line to the opposite spring line. The filter material for concrete pipe shall be a minimum of 2' wide for pipes with a nominal diameter of 24" or less, larger diameters shall have filter material 4' in width. Pipes with connecting bands shall have filter material extending a minimum of 3 inches beyond each side of the band, between it and the pipe. ***The fabric shall not be installed under the connection band as this results in a poor fit between the pipe and the connection band.*** The fabric shall be installed and secured in a manner that prevents wrinkles and folds or displacement during backfill operations. All storm drain pipe lift holes shall be covered with a 2' wide strip of filter material of sufficient length to extend to the spring line of the pipe prior to backfilling.
- B. After the storm drain and end sections are laid and jointed, it shall be backfilled in accordance with the following requirements.
 - 1. Backfilling shall be done with material free from large clods and foreign matter, and placed evenly and carefully around and over the pipe in six (6)

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inch maximum layers, each layer being thoroughly tamped until twelve (12) inches of cover exists over the pipe. The remainder of the backfilling may be placed and tamped in horizontal layers to within eight (8) inches of the finished subgrade elevation. Tamping shall be performed using suitable pneumatic compactors or approved equal. Compaction equipment specifically designed for these purposes must be present and operational at the job site and shall be utilized throughout the length and depth of the trench to obtain uniform compaction. Where settlement is important and where excavation has been made through permanent pavements, curbs, and driveways, and sidewalks, or where structures are undercut by excavation, it shall be the Contractor's responsibility to provide compaction of the backfill material to 95% of its maximum density at plus or minus twenty percent (20%) of its optimum moisture as per VTM-1. All other areas of backfill shall be compacted to provide 90% of its maximum density at optimum moisture. Surplus material shall be disposed of by the Contractor. Pavement and shoulders are to be cleaned of excess material immediately after backfill.

2. Compaction Tests: The City, or its authorized representatives, reserve the right to perform compaction tests on any or all portion(s) of backfill placed in the trench at no costs to the Contractor. However, in the event the compaction of this backfill is not in compliance with the specification, Section 10.03. B,1 then the Contractor shall take corrective measures at no costs to the City to bring the backfill within the limits of the Specifications, Section 10.03.B,1. The Contractor shall then be responsible for reimbursing the City all costs associated with the performance of compaction test(s) in those sections of the backfill that failed the compaction test(s). If however the tests should bear out that the backfill is sufficiently compacted, the City will absorb all costs thereof.
3. Permissible construction tolerances between the proposed inverts as shown on the construction plans and the as-built condition shall not exceed 0.10'.
4. Special Installation considerations for PVC and PE Storm Drain Pipe:
 - a. The contractor is responsible for adhering to all manufacturer and ASTM Designation D-2321 installation specifications.
 - b. General installation methods shall be as specified for flexible pipe in the Virginia Department of Transportation Road and Bridge Specifications except where these specifications are in conflict with City or manufacturer specifications.
 - c. Haunching - The haunching area is the most important in terms of

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- limiting the deflection of a flexible pipe. This is the area that should be compacted to the Proctor density specified in the plans.
- d. Initial Backfill - Initial backfill begins at the haunch of the pipe to a plane 6 inches to 12 inches above the pipe. Under shallow cover conditions the backfill must be compacted to the specified proctor density up to the pavement section or finished grade. All compaction must be completely achieved during placement of backfill material.
 - e. If compaction equipment is used to prepare the bedding and backfill for the road surface, it should not be used within 3 feet of the top of the pipe and then only if the pipe zone soil density has been previously compacted to a minimum 85% standard Proctor density.
 - f. Pipe Zone Materials - Pipe zone materials include the materials in the haunching area and the initial backfill. They must meet plan specifications.
 - g. Compaction Techniques - Flooding or jetting are not acceptable compaction methods. All compaction must be obtained by mechanical or hand tamping methods as specified in the Virginia Department of Transportation Road and Bridge Specifications Section 302.
 - h. Backfill materials and the specified Proctor density of the haunching and backfill materials may be checked by an independent soils engineering firm at the City's option.
 - i. The City reserves the right to test flexible pipe for excessive deflection. Deflection may not exceed 5% of the minimum diameter as specified in ASTM D 3034.
 - j. ***For PVC Pipe installed*** under shallow cover conditions, (3 feet or less) Virginia Department of Transportation size 57 angular stone must be used in the bedding, haunching and backfill areas up to the top of the pipe. A minimum 95% proctor density is required.
 - k. ***P.E. Pipe shall be installed in accordance with ASTM D-2321 except that bedding and backfill shall be VDOT type 57, 25 or 26 stone where the pipe is underneath the pavement. In "behind the curb" installations backfill and bedding shall be select material or in accordance with AASTO M145 Group A-1, A-2-4, A-2-5, A-2-6 or A-3 (GW, GP, SW, GM and SM) only. Polyethylene storm pipe shall be installed in accordance with VDOT PB-1. Bedding and backfill material shall be compacted to 95% proctor density and shall extend***

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6" below, 24" laterally and 12" above the pipe.

1. Uncovered pipe may not be left in an open trench at the end of the work day. All pipe that has been placed in the open trench must be properly bedded and backfilled in order to prevent wash out or flotation from over night rainfall.

10.04 MEASUREMENT AND PAYMENT:

- A. Reinforced Concrete Pipe for Storm Drains: The length of pipe completed and accepted will be field measured from center of drainage structure to center of drainage structure.

The length so determined will be paid for at the unit price bid per lineal foot for the size specified in the Proposal.

- B. Corrugated Steel Pipe for Storm Drains: Same as 10.04 A.
- C. Corrugated Aluminum Pipe for Storm Drains: Same as 10.04 A.
- D. PVC and PE Storm Drain Pipes: Same as 10.04A. Special installation considerations for PVC and PE Storm Drain Pipe will not be measured and paid as such, but will be incidental to the lineal foot price of the PVC or PE Storm Drain Pipe.
- E. Connections to existing drainage structures will not measured and paid as such, but will be incidental to the lineal foot price of the incoming storm drainage pipe.
- F. Flared end sections shall be measured and paid for at the contract price per each at the diameter specified in the Unit Price Table.
- G. Erosion control filter material for pipe joints will not be measured and paid as such, but will be incidental to the lineal foot price of storm drain pipe.