

SECTION 302

DRAINAGE STRUCTURES

I. GENERAL

1.1. DESCRIPTION OF WORK

The Contractor shall furnish all labor, supervision, material (except as herein provided), tools, equipment, supplies, and services; and, shall perform all Work necessary for the installation and construction of pipe culverts, endwalls, box culverts, precast concrete and metal arches, storm drains, drop inlets, manholes, spring boxes, junction boxes, and intake boxes and removing and replacing existing structures in accordance with these specifications and in conformity to the lines and grades shown in the Contract Documents or as designated by the Owner.

1.2. MATERIALS

Materials shall be furnished by the Contractor in accordance with Section 200.

1.3. SUBMITTALS

- A. Submittals shall be made by the Contractor in accordance with the procedures set forth in Section 105 and as described below.
- B. The Contractor shall furnish copies of the manufacturer's specifications and details for cast in place installations indicated in the Contract Documents, Standard Details, and the *VDOT Road and Bridge Standards*, latest edition, listing specific materials proposed.
- C. Submittal of designs for precast items included in the Contract Documents will not be required provided fabrication is in accordance with the *VDOT Road and Bridge Standards*, latest edition. Submittal of designs for precast structures on VDOT's approved list will not be required provided the Contractor submits a certification that the item will be fabricated in accordance with the pre-approved design Drawings.
- D. The Contractor shall furnish the Owner with an affidavit stating that products to be installed on this project comply with specification requirements.
- E. The "Acceptance Procedures for Aggregates" shall be in accordance with Section 200.

II. EXECUTION

2.1. PROCEDURES

- A. Trenching, excavation, bedding and backfill operations shall be performed in accordance with the requirements of Section 303.
- B. The Contractor shall execute the Work in accordance with the latest edition of the *VDOT Road and Bridge Specifications*, Section 302.03, Procedures, however, Post Installation Inspection of Storm Sewer Pipes and Culverts shall be performed in accordance with 302.2.1.C below. Any references to "Engineer" or VDOT personnel shall mean the "Owner".

C. Post Installation Inspection of Storm Sewer Pipes and Culverts

In addition to the visual inspection if performed by the Owner during the initial installation of storm sewer pipes and pipe culverts, a post installation visual/video camera inspection shall be conducted by the Contractor in accordance with the requirements of this specification and VDOT VTM 123 on all pipes identified in the Contract Documents as storm sewer pipe and a selected number of pipe culverts. For the purposes of this Section all pipe installations not identified in the Contract Documents as storm sewer pipe are considered pipe culverts. Post installation Inspections shall be performed on straight line and radial installations.

For pipe culverts, a minimum of one pipe installation for each size of each material type utilized on the project will be randomly selected by the Owner for inspection, however, in no case will the amount of pipe subject to inspection be less than ten percent of the total contract amount for the size and material type indicated. Where possible, for all installations in which the pipe or culvert's size, orientation, or location permit deflection to be easily visually identified, (as verified with the Owner) the Contractor may perform visual inspections in lieu of video inspections. If defects as described herein are noted during the inspection, the Owner may require additional pipe installations of that size and/or material be inspected. The Contractor shall coordinate and schedule all post installation inspections so that these are made in the presence of the Owner. The post installation inspection shall be performed no sooner than 30 days after completion of the pipe installation and placement of final cover (except for pavement structure). The Contractor shall issue a report detailing all issues or deficiencies noted during the inspection (including a remediation plan for each deficiency noted where applicable) no later than 5 days after completion of the inspection.

While the intent of this requirement is to perform the post installation inspection prior to paving, project scheduling may dictate that a particular site be paved before the end of the 30 day period. In such cases, a preliminary inspection of the pipe shall be made, prior to paving over it, to insure that the pipe has been properly installed and is performing well. Performing such a preliminary inspection prior to paving will not relieve the Contractor from the requirement to perform the post installation inspection after the 30 day period.

The Contractor's inspection report shall identify and address any of the following items observed during the post installation inspection including identifying any proposed remediation measures the Contractor plans to perform where applicable. Remediation measures may consist of repairing or replacing the defective pipe section(s) or a combination of the two where differing conditions exist within the same run of pipe. Where permitted as an option, remediation methods for the various installation defects shall be proposed by the Contractor, reviewed with the Owner and must have the Owner's approval prior to implementation of the corrective action. Remediation shall be the sole responsibility of the Contractor. Further, if remediation measures are shown to be necessary, any time associated with such measures shall be reflected in the impact to the Contractor's progress schedule (may take the form of a time impact analysis, where required by the scheduling requirements) and will not relieve the Contractor of his responsibilities to finish the work required by the contract within the contract time limits or form the basis for any claim of delay where such remediation measures are determined to be a result of the Contractor's fault, omission or negligence.

Upon completion of any corrective remedial measures, the corrected installations are to be re-inspected prior to final acceptance of the project utilizing the test methods identified in VDOT VTM 123.

The following criteria shall form the basis for inspections for the respective pipe or culvert types listed:

1. Concrete Pipe\Culverts:

- a. Misalignment: Vertical and horizontal alignment of the pipe culvert or storm drain pipe barrel shall be checked by sighting along the crown, invert and sides of the pipe, and by checking for sagging, faulting and invert heaving. For the purposes of this provision faulting is defined as differential settlement between joints of the pipe, creating a non-uniform profile of the pipe. The person assigned by the Contractor to perform the inspection should take into account pipe or culvert laid with a designed camber or grade change in accordance with project or site requirements. Horizontal alignment shall be checked for straightness or smooth curvature. Any issues involving incorrect horizontal and/or vertical alignment shall be noted in the inspection report. If any vertical and/or horizontal misalignment problems are visually noted by the Owner or in the inspection report, a further evaluation shall be conducted by the Owner to determine the impact of the misalignment on the joints and wall of the pipe to ascertain what corrective actions are needed. All corrective actions determined necessary by the Owner that are a result of the Contractor's negligence, omission or fault shall be the sole responsibility of the Contractor to remedy.
- b. Joints: Leaking joints may be detected during low flows by visual observation of the joints or checking around the ends of pipes or culverts for evidence of piping or seepage.

Differential movement, cracks, spalling, improper gasket placement, movement or settlement of pipe\culvert sections, and leakage shall be noted by the Contractor in the report. Joint separation greater than one inch shall be remediated by the Contractor at his expense to the satisfaction of the Owner. Evidence of soil migration through the joint will be further evaluated by the Owner to determine the level of corrective action necessary. All corrective actions determined necessary by the Owner that are a result of the Contractor's negligence, omission or fault shall be the sole responsibility of the Contractor to remedy.

- c. Cracks: Longitudinal cracks with a width less than one hundredth of an inch (0.01) are considered hairline and minor. They shall be noted in the inspection report; however, no remedial action is necessary.

Longitudinal cracks having a width equal to or greater than one hundredth of an inch (0.01) but equal to or less than one tenth of an inch (0.1) and determined by the Owner to be detrimental to the structure shall be sealed by a method proposed by the pipe\culvert manufacturer and approved by the Owner. Pipes or culverts having longitudinal cracks with widths greater than one tenth of an inch (0.1) and determined to be beyond the limits of a satisfactory structural repair shall be replaced by the Contractor at his expense to the satisfaction of the Owner.

Pipes or culverts having displacement across the crack greater than 0.1 inch but less than 0.3 inch shall be remediated. Remediation methods shall be in

accordance with recommendations of the pipe or culvert manufacturer, be acceptable to and authorized by the Owner before implementation and shall be the sole responsibility of the Contractor. Pipes\culverts having displacement across the crack greater than 0.3 inch shall be replaced by the Contractor at his expense to the satisfaction of the Owner.

Transverse cracks will be evaluated using the same criteria as indicated above for longitudinal cracks.

- d. Spalls: Spalling is defined as a localized pop-out of concrete along the wall of the pipe\culvert generally caused by corrosion of the steel reinforcement or at the edges of longitudinal or circumferential cracks. Spalling may be detected by visual examination of the concrete along the edges of the crack. The person conducting the inspection shall check for possible delamination. If delamination is noted or if a hollow sound is produced when the area is tapped with a device such as a hammer, the pipe\culvert shall be remediated. Remediation methods shall be in accordance with recommendations of the pipe\culvert manufacturer, be acceptable to and authorized by the Owner before proceeding, and shall be the sole responsibility of the Contractor.
- e. Slabbing: Any pipe\culvert experiencing slabbing shall be remediated. Slabbing is a structural failure of the pipe\culvert that results from radial or diagonal tension forces in the pipe\culvert. These failures appear as a separation of the concrete from the reinforcing steel near the crown or invert of the pipe\culvert and may span the entire length of a pipe or culvert section (joint to joint). Remediation methods shall be in accordance with recommendations of the pipe or culvert manufacturer, be acceptable to and authorized by the Owner before proceeding, and shall be the sole responsibility of the Contractor. Where slabbing is of such magnitude that, in the opinion of the Owner the integrity or service life of the pipe or culvert is severely compromised, the section(s) of pipe or culvert exhibiting such deficiency shall be replaced at the Contractor's expense to the satisfaction of the Owner.

Remediation efforts and percentage of payment shall apply to the entire section(s) of the deflected pipe or culvert, joint to joint. The cost of the remedial measures (including removal and replacement of the pipe, if necessary) and the re-inspection of the remediated pipe necessitated as a result of the Contractor's negligence, omission or fault shall be the contractual and financial responsibility of the Contractor.

2. Thermoplastic Pipe\Culvert:

- a. Misalignment: Vertical and horizontal alignment of the pipe culvert or storm drain pipe barrel(s) shall be checked by sighting along the crown, invert and sides of the pipe, and by checking for sagging, faulting and invert heaving. The person assigned by the Contractor to perform the inspection should take into account pipes\culverts laid with a designed camber or grade change. Horizontal alignment shall be checked for straightness or smooth curvature. Any issues with horizontal and/or vertical alignment shall be noted in the inspection report. If any vertical and/or horizontal misalignment problems are noted in the

inspection, a further evaluation will be performed by the Owner to determine the impact of the misalignment on the joints and wall of the pipe\culvert to ascertain what corrective actions are needed. All corrective actions determined necessary by the Owner that are a result of the Contractor's negligence, omission or fault shall be the sole responsibility of the Contractor to remedy.

- b. Cracks: Cracks or splits in the interior wall of the pipe shall be remediated. Remediation methods shall be in accordance with recommendations of the pipe manufacturer, be acceptable to and authorized by the Owner before proceeding, and shall be the sole responsibility of the Contractor
- c. Joints: Pipes\culverts showing evidence of crushing at the joints shall be remediated. Differential movement, improper joint sealing, movement or settlement of pipe\culvert sections, and leakage shall be noted in the inspection report. Joint separation of greater than 1 inch shall be remediated. Evidence of soil migration through the joint will be further investigated by the Owner to determine the level of remedial action required by the Contractor. Remediation methods shall be in accordance with recommendations of the pipe manufacturer, be acceptable to and authorized by the Owner before proceeding. All corrective actions determined necessary by the Owner that are a result of the Contractor's negligence, omission or fault shall be the sole responsibility of the Contractor to remedy.
- d. Buckling, bulging, and racking: Flat spots or dents at the crown, sides or flow line of the pipe due to racking shall be noted in the inspection report and will be evaluated by the Owner. Areas of wall buckling and bulging shall also be noted in the inspection report and evaluated by the Owner for corrective action if deemed necessary by the Owner. All corrective actions determined necessary by the Owner shall be the sole responsibility of the Contractor.
- e. Deflection: Any one of several methods may be used to measure deflection of thermoplastic pipe\culvert (laser profiler, mandrel, direct manual measure, etc.) If the initial inspection indicates the pipe\culvert has deflected more than 5 percent of its original diameter, and if the original inspection was performed using a video camera, then a mandrel test shall also be performed in accordance with VDOT VTM 123. All deflections shall be noted in the inspection report. Deflections of less than 5 percent of the original pipe\culvert's diameter shall not require remediation. If the pipe\culvert is deflected greater than 5 percent of the original diameter, the pipe\culvert shall be replaced by the Contractor at his expense to the satisfaction of the Owner

Remediation efforts and percentage of payment shall apply to the entire section(s) of the deflected pipe or culvert, joint to joint. The cost of the remedial measures (including removal and replacement of the pipe, if necessary) and the re-inspection of the remediated pipe necessitated as a result of the Contractor's negligence, omission or fault shall be the contractual and financial responsibility of the Contractor.

3. Metal Pipe\Culvert:

- a. Misalignment: Vertical and horizontal alignment of the pipe culvert or storm drain pipe barrel shall be checked by sighting along the crown, invert and sides of the pipe\culvert, and by checking for sagging, faulting and invert heaving. The person assigned by the Contractor to perform the inspection should take into account pipe laid with a designed camber or grade change. Horizontal alignment shall be checked for straightness or smooth curvature. Any issues with horizontal and/or vertical alignment shall be noted in the inspection report for evaluation by the Owner. If any vertical and/or horizontal misalignment problems are noted in the inspection, further evaluation will be conducted by the Owner to determine the impact of the misalignment on the joints and wall of the pipe\culvert to ascertain what corrective actions by the Contractor are needed. All corrective actions determined necessary by the Owner that are a result of the Contractor's negligence, omission or fault shall be the sole responsibility of the Contractor to remedy.
- b. Buckling, bulging, and racking: Flat spots or dents at the crown, sides or flow line of the pipe due to racking shall be noted by the Contractor's inspector in the inspection report and will be evaluated by the Owner for possible remediation by the Contractor. Areas of wall buckling and bulging shall also be noted in the inspection report and evaluated by the Owner for possible remediation by the Contractor. If the Owner determines corrective actions are necessary they shall be in accordance with the pipe\culvert manufacturer's recommendations, be acceptable to and authorized by the Owner prior to implementation and be the sole responsibility of the Contractor.
- c. Joints: Pipes showing evidence of crushing at the joints shall be remediated. Differential movement, improper joint sealing, movement or settlement of pipe sections, and leakage shall be noted in the report. Joint separation of greater than 1.0 inch shall be remediated. Evidence of soil migration through the joint will be further investigated by the Owner to determine the level of remedial action required by the Contractor. All corrective actions determined necessary by the Owner that are a result of the Contractor's negligence, omission or fault shall be the sole responsibility of the Contractor to remedy.
- d. Coating: Areas of the pipe where the original coating has been scratched, scoured or peeled shall be noted in the inspection report and evaluated by the Owner to determine the need for immediate repair. If repairs are required they shall be performed by and at the expense of the Contractor in accordance with the recommendations of the pipe\culvert coating manufacturer.
- e. Deflection: Any one of several methods may be used to measure deflection of metal pipe\culvert (laser profiler, mandrel, direct manual measure, etc.) If the initial inspection indicates the pipe\culvert has deflected more than 5 percent or more of its original diameter, and if the original inspection was performed using a video camera, then a mandrel test shall also be performed in accordance with VDOT VTM 123. All deflections shall be noted in the inspection report. Deflections of less than 5 percent of the original pipe\culvert's diameter shall not require remediation. If the pipe\culvert is deflected greater than 5 percent of the original diameter, the pipe shall be replaced by the Contractor at his expense to the satisfaction of the Owner

Remediation efforts and percentage of payment shall apply to the entire section(s) of the deflected pipe or culvert, joint to joint. The cost of the remedial measures (including removal and replacement of the pipe, if necessary) and the re-inspection of the remediated pipe necessitated as a result of the Contractor's negligence, omission or fault shall be the contractual and financial responsibility of the Contractor.

D. Cleaning

Upon completion, each pipe and structure shall be cleaned of silt, debris, and foreign matter and shall be kept clear of such accumulation until final acceptance.

III. MEASUREMENT FOR PAYMENT

- A. The cost of excavation, backfill, and disposal of surplus material for drop inlets, intake boxes, manholes both new and reconstructed, spring boxes, junction boxes, and base sections of pipe tee units used as drop inlets and manholes shall be included in the bid price for such items. No additional or separate payment will be made. In the event steps or invert shaping are required, the cost thereof shall also be included in the price for such items.
- B. Bedding stone depth shall be 6-inches and shall be considered incidental to the pipe and structures.
- C. Undercut excavation and the replacement of excavated undercut material shall be as specified in Section 303.
- D. Pipe will be measured in linear feet of each size pipe and material type installed. Pipe will be measured through the fittings from center of the structure to center of structure or to the terminal end. When a partial section is required, the actual length of the partial section will be measured in place. Pipe shall be paid for at the contract unit price per linear foot, complete in place. Payment will include the cost of the following:
1. Backfilling, compacting, and compaction testing
 2. Bedding
 3. Cleaning prior to acceptance, as required
 4. Dewatering
 5. Disposal of surplus material
 6. Excavation
 7. Joint Wrapping & Sealing, including geotextile fabric
 8. Main line fittings
 9. Pipe anchor blocks
 10. Restoration in right-of-way and shoulders and easements (including curb and gutter restoration), unless otherwise specified in the Contract Documents.
 11. Storm sewer and appurtenances
 12. Stripping and stockpiling topsoil
 13. Temporary seeding and stabilization
 14. Temporary sheeting and bracing.
- E. Pipe culverts will be measured and paid in linear feet. Pipe will be measured through the fittings from center of the structure to center of structure or to the terminal end. When a partial section is required, the actual length of the partial section will be measured in place.

- F. Pipe tees and elbows will not be measured separately.
- G. Pipe reducers will be measured and paid in linear feet of pipe for payment at the larger pipe size.
- H. Jacked pipe will be measured in linear feet to the nearest 1/10 of a foot. Jacked pipe will be paid at the contract unit price per linear foot for each size pipe installed, complete in place including all work associated with bore pit.
- I. Reinstalled pipe will be measured and paid in linear feet along a line parallel to the flow line. This price shall include excavation involved in removing pipe, hauling, cleaning, relaying, backfilling, necessary cutting for joining to other sections of pipe, furnishing new coupling bands, disposing of surplus excavation, disposing of surplus and damaged materials, and replacing any otherwise usable sections damaged or broken because of the negligence of the Contractor.
- J. End sections will be measured in units of each, complete-in-place.
- K. End walls and arch substructures will be measured per each.
- L. Box culverts will be measured in linear feet along the centerline of the barrel from face of curtain wall to face of curtain wall. This price shall include all work including, but not limited to designing, casting, reinforcing, installing, bedding, waterproofing, sealing joints, anchoring, and providing buffer zones for multiple lines.
- M. Pipe grates will be measured and paid in linear feet or each, complete and in place, as indicated on the Bid form, unless included in another Bid item. This price shall include fabricating, furnishing, galvanizing, and installing.
- N. Drop inlets, yard inlets, catch basins, and intake boxes will be measured as each as complete units, including the frame and grate or cover. Drop inlets, yard inlets, catch basins, and intake boxes will be paid for at the contract unit price per each. Where curb or curb and gutter extend along the drop inlet, the contract unit price for drop inlets shall include that part of the curb or gutter within the limits of the structure.
- O. Base sections of pipe tee units used as drop inlets and manholes will be measured and paid in linear feet horizontally of pipe specified. The riser section and additional costs for the tee shall be included in the price for the drop inlet or manhole.
- P. Manhole (4- or 5-foot diameter) installed complete in place, 0- to 6-foot in depth. Measurements will be made to the nearest foot from the bottom of the frame and cover to the invert out. Payment will be made at the unit price bid for each standard depth manhole (0- to 6-foot) installed and satisfactorily tested, and will include the cost of the following:
 - 1. All appurtenances required for satisfactory operation
 - 2. Bedding
 - 3. Cleaning prior to acceptance, as required
 - 4. Dewatering
 - 5. Excavation, bedding, backfill, and compaction
 - 6. Manhole, complete including frame and cover, benches, inverts and troughs
 - 7. Openings and seals
 - 8. Sheeting and shoring
 - 9. Steps, unless otherwise noted

- Q. Manhole (4- or 5-foot diameter) Extra Depth, installed complete in place, in excess of 6-feet in depth will be made based on the vertical feet of manhole installed in excess of 6-feet, measured to the nearest foot from 6-feet below the bottom of the frame and cover to the invert out in depth.

Payment will be made at the unit price bid for each additional vertical foot of manhole (in excess of 6-feet in depth) installed and satisfactorily tested and will include the cost of the following:

1. All appurtenances required for satisfactory operation
2. Cleaning prior to acceptance, as required
3. Dewatering
4. Excavation, bedding, backfill, and compaction
5. Openings and seals
6. Sheeting and shoring
7. Steps, unless otherwise noted

- R. Conflict Manhole, installed complete in place.

Measurement will be made as each. Payment will be made at the unit price bid for each conflict manhole installed and satisfactorily tested will include the cost of the following:

1. All appurtenances required for satisfactory operation
2. Bedding
3. Cleaning prior to acceptance, as required
4. Dewatering
5. Ductile iron pipe
6. Excavation, bedding, backfill, and compaction
7. Manhole, complete including benches, inverts and troughs, and frame and cover
8. Openings and seals
9. Sheeting and shoring
10. Steps, unless otherwise noted

- S. Concrete spring boxes will be measured and paid as each.

- T. Junction boxes will be measured as a complete unit including frame and cover, and paid as each.

- U. Reconstructed manholes will be measured and paid as each as a complete unit.

- V. Precast arches will be measured and paid in linear feet along the centerline of the invert from face of headwall to face of headwall. This price shall include designing, forming, casting, reinforcing, excavating, wingwalls, installing, waterproofing, sealing joints, anchoring and bedding, and providing buffer zones for multiple lines. The cost for cast-in-place work other than that specified in the Contract Documents shall be included in the price for precast arches.

- W. Post Installation Inspection of Storm Pipes and Culverts shall be measured and paid in linear feet of televised pipe in accordance with Section 811, Television Inspection. The cost of remedial measures (including removal and replacement of the pipe, if necessary) and the re-inspection of the remediated pipe necessitated as a result of the Contractor's negligence, omission or fault shall be the contractual and financial responsibility of the Contractor.

End of Section