

GUIDELINES — FOR PROJECTS REQUIRING DRAINAGE STRUCTURES.

SS30204-0613

March 14, 2013

VIRGINIA DEPARTMENT OF TRANSPORTATION
2007 ROAD AND BRIDGE SUPPLEMENTAL SPECIFICATIONS**SUPPLEMENTAL SECTION 302—DRAINAGE STRUCTURES****SECTION 302—DRAINAGE STRUCTURES** of the Specifications is amended as follows:**Section 302.03(b) Precast Drainage Structures** is amended to replace the second paragraph with the following:

Requests for approval of a precast design shall include detailed plans and supporting computations that have been reviewed by a registered Professional Engineer having at least 5 years experience in structural design of precast structures or components proposed and licensed in the Commonwealth. Unless otherwise specified, concrete exposed to freeze/thaw environments shall conform to Section 217.02 of the Specifications and shall have a design strength at 28 days of at least 4,000 pounds per square inch and an air content of 6 ± 2 percent. Concrete not exposed to freeze/thaw environments shall be exempt from the requirements of Section 217.02(a) of the Specifications. The design of the concrete mixture and the method of casting, curing handling and erecting of precast units shall be subject to review by the Engineer. Precast units may be shipped after reaching 85 percent of the design strength as determined by control cylinders. Sampling and testing concrete strength shall be performed using control cylinders in accordance with ASTM C31 and C39 at a rate of one set of cylinders per lot. A lot is defined as a maximum 250 cubic yards or a single weeks production (whichever quantity is less) of precast concrete from each batching operation, being of like material, strength and manufactured by the same process. Variations of lot definition will be governed by applicable specifications and approved by the Engineer. Control cylinders used for acceptance testing shall be cured under the same conditions as the concrete the cylinders represent. Units shall retain their structural integrity during shipment and shall be subject to inspection at the job site. Approval to use precast units shall not be construed as waiving the size and weight limitations specified in Section 107.21 of the Specifications.

Section 302.03(b)2. Precast arches is replaced with the following:

2. **Precast arches** shall conform to the applicable requirements of the current AASHTO's *LRFD Bridge Design Specifications* and VDOT modifications (current VDOT I&IM-S&B-80) and the following modifications:

- a. **Protection against corrosion:** The concrete cover of reinforcement shall be at least 1 1/2 inches.

Reinforcing steel for arches in 0 to 2 foot fills, in corrosive or marine environments, or in other severe exposure conditions shall be corrosion resistant reinforcing steel, Class I. When corrosion resistant reinforcing steel is required, the minimum cover specified shall not be reduced.

Exposed reinforcing bars, inserts, and plates intended for bonding with future extensions shall be protected from corrosion as directed by the Engineer.

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Reinforcement shall be designed and detailed in consideration of fabrication and construction tolerances so that the minimum required cover and proper positioning of reinforcement shall be maintained.

- b.—**Anchorage:** Sufficient anchorage shall be provided at the terminus of lines of precast units. Anchorage may consist of a cast-in-place end section at least 3 feet in length with a headwall or collar around the precast unit(s) provided adequate connection can be made between the collar and units.
- c.—**Joints:** Joints between units shall be sealed by preformed plastic or mastic gaskets or grout. When preformed gaskets are used, they shall be of a type listed on the Department's approved products list.
- d. **Pipe openings:** Pipe openings will not be allowed in the precast arch but may be provided through the wingwalls. When required, openings shall conform to the requirements of (b)1.b. herein.

Section 302.03(b)3. Precast box culverts is replaced with the following:

- 3. **Precast box culverts** shall conform to the applicable requirements of the current *AASHTO's LRFD Bridge Design Specifications* and VDOT modifications (current VDOT I&IM-S&B-80) and the following modifications:

- a. Precast Box Culverts shall conform to the applicable material requirements of ASTM C1577. The design shall be a Special Design which need not conform to the reinforcing steel and geometry shown in the design tables and the appendix in ASTM C1577.
- b. For protection against corrosion, the following minimum concrete cover shall be provided for reinforcement: For boxes with more than 2 feet of fill over the top slab: 1 1/2 inches. For boxes with less than 2 feet of fill over the top slab: top reinforcement of top slab: 2 1/2 inches; bottom reinforcement of top slab: 2 inches; all other reinforcement: 1 1/2 inches.

Reinforcing steel for arches in 0 to 2 foot fills, in corrosive or marine environments, or in other severe exposure conditions shall be corrosion resistant reinforcing steel, Class I. When corrosion resistant reinforcing steel is required, the minimum cover specified shall not be reduced.

- c. The type of sealant used in joints between units shall be from the Department's Approved List of Preformed Plastic or Mastic Gaskets.

Where double or greater lines of precast units are used, a buffer zone of 3 to 6 inches between lines shall be provided. This buffer zone shall be backfilled with porous backfill conforming to the requirements of Section 204. The porous backfill shall be drained by a 3-inch-diameter weep hole, formed by non-rigid tubing, located at the top of the bottom haunch, centered in the outlet end section and at approximately 50-foot intervals along the length of the box. Weep holes shall be covered with a 3-foot-square section of filter barrier cloth firmly attached to the outside of the box. A 3-foot width of filter barrier cloth shall also be centered over the buffer zone for the entire length of the structure after placement of the porous backfill material. Filter barrier cloth shall conform to the requirements of Section 245.

Forming weep holes and furnishing and placing of the filter barrier cloth shall be included in the price bid per linear foot for the precast box culvert.

- d. At the terminus of precast units, sufficient anchorage shall be provided. This anchorage may consist of a cast-in-place end section at least 3 feet in length with a headwall and curtain

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wall or a collar cast-in-place around the units provided adequate connection can be made between the collar and units.

When the ends of precast units are skewed, the end section shall be cast monolithically. The skew may be provided by forming, saw cutting, or other methods approved by the Engineer. Regardless of the method used, the variation in the precast unit from the exact skew shall be not greater than 1 1/2 inches at any point.

- e. Pipe openings shall conform to the requirements of 1.b. herein.
- f. Bedding and backfill shall be in accordance with Standard PB-1 for box culverts.

Section 302.03 Procedures is amended to add the following

(d) **Post Installation Inspection**

In addition to the visual inspection performed by the Department 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 VTM 123 on all storm sewer pipe and a selected number of pipe culverts. For the purposes of this Section, a storm sewer pipe is defined as either a component of a storm sewer system as defined in Section 101.02 of the Specifications or any pipe identified on the plans as storm sewer pipe. All other pipe shall be 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 Engineer 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 Engineer) the Contractor may perform visual inspections in lieu of video inspections. If defects as described herein are noted during the inspection, the Engineer 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 Engineer. 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.

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Where permitted as an option, remediation methods for the various installation defects shall be proposed by the Contractor, reviewed with the Engineer and must have the Engineer'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 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 Engineer or in the inspection report, a further evaluation shall be conducted by the Engineer 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 Engineer 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 Engineer. . Evidence of soil migration through the joint will be further evaluated by the Engineer to determine the level of corrective action necessary. All corrective actions determined necessary by the Engineer that are a result of the Contractor's negligence, omission or fault shall be the sole responsibility of the Contractor to remedy.

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- 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 Engineer to be detrimental to the structure shall be sealed by a method proposed by the pipe\culvert manufacturer and approved by the Engineer. 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 Engineer.

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 Engineer 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 Engineer.

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 Engineer 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 Engineer before proceeding, and shall be the sole responsibility of the Contractor. Where slabbing is of such magnitude that, in the opinion of the Engineer 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 Engineer.

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,

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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 Engineer 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 Engineer 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 Engineer 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 Engineer 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 Engineer before proceeding. All corrective actions determined necessary by the Engineer 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 Engineer. Areas of wall buckling and bulging shall also be noted in the inspection report and evaluated by the Engineer for corrective action if deemed necessary by the Engineer. All corrective actions determined necessary by the Engineer 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 7.5 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 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. Deflection of 5 percent up to 7.4 percent will be evaluated by the Engineer. If the pipe\culvert experiences additional defects along with deflection of 5 percent up to 7.4 percent of the original pipe\culvert's diameter, the pipe\culvert shall be remediated. Remediation methods shall be in accordance with recommendations of the pipe\culvert

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manufacturer, be acceptable to and authorized by the Engineer before proceeding, and shall be the sole responsibility of the Contractor.

If the pipe\culvert is deflected 7.5 percent or greater of the original diameter, the pipe\culvert shall be replaced by the Contractor at his expense to the satisfaction of the Engineer

In lieu of the options noted above for remediation of deflection in thermoplastic pipe\culvert installations, the Contractor may elect to follow the payment schedule below:

Amount of Deflection	Percent of Payment
0.0 % TO 5.0%	100% of Unit Bid Price
5.1% to 7.5%	75% of Unit Bid Price
Greater than 7.5%	Remove and Replace at Contractor's Expense

Remediation efforts and payment shall apply to the entire section(s) of the deflected pipe or culvert, joint to joint.

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 Engineer. If any vertical and/or horizontal misalignment problems are noted in the inspection, further evaluation will be conducted by the Engineer 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 Engineer 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 Engineer for possible remediation by the Contractor. Areas of wall buckling and bulging shall also be noted in the inspection report and evaluated by the Engineer for possible remediation by the Contractor. If the Engineer determines corrective actions are necessary they shall be in accordance with the pipe\culvert manufacturer's recommendations, be acceptable to and authorized by the Engineer 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 Engineer to determine the level of remedial action required by the

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Contractor. All corrective actions determined necessary by the Engineer 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 Engineer 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 7.5 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 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. Deflection of 5 percent up to 7.4 percent will be evaluated by the Engineer. If the pipe\culvert experiences additional defects along with deflection of 5 percent up to 7.4 percent of the original pipe\culvert's diameter, 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 Engineer before proceeding, and shall be the sole responsibility of the Contractor.

If the pipe\culvert is deflected 7.5 percent or greater of the original diameter, the pipe shall be replaced by the Contractor at his expense to the satisfaction of the Engineer

In lieu of the options noted above for remediation of metal pipe\CULVERT, the Contractor may elect to follow the payment schedule below:

Amount of Deflection	Percent of Payment
0.0 % TO 5.0%	100% of Unit Bid Price
5.1% to 7.5%	75% of Unit Bid Price
Greater than 7.5%	Remove and Replace at Contractors Expense

Remediation efforts and percentage of payment shall apply to the entire section(s) of the deflected pipe or culvert, joint to joint.

Section 302.04 Measurement and Payment is amended to add the following:

Post installation inspection shall be measured and paid for at the contract unit price per linear foot. This price shall include performing visual and video camera inspection(s), preparing and furnishing documentation to include narratives and video media in accordance with the requirements herein and VTM 123.

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.

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Payment will be made under:

Pay Item	Pay Unit
Post installation inspection	Linear Foot

Section 302.04 Measurement and Payment is amended to add the following:

Epoxy-coated reinforcing steel, when a pay item, will be measured in pounds of uncoated steel and will be paid for at the contract unit price per pound. The weight will be computed from the theoretical weights of the nominal sizes of steel specified and placed in the structure. Measurement will not be made for epoxy-coating material. This price shall include furnishing steel and epoxy-coating material; applying coating material; fabricating, shipping, and placing epoxy-coated reinforcement in the structure; and necessary repairing of epoxy coatings.

Payment will be made under:

Pay Item	Pay Unit
Epoxy-coated reinforcing steel	Pound

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