

# APPENDIX K

## PIPE INSPECTION

**\*\*Virginia Test Method – 123\*\***

### *Post Installation Inspection of Buried Storm Drain Pipe and Pipe Culverts*

**June 25, 2010**

#### **SCOPE**

For all roadway projects that are constructed by private contractors for VDOT and for all roadway projects constructed by others that are or will be proposed to be accepted into the VDOT highway system, a visual/video camera post installation inspection is required on all storm sewer pipes and for a selected number of pipe culverts in accordance with the instructions contained in this VTM and Section 302.03 of the VDOT Road and Bridge Specifications. The video camera inspection is to be conducted with a VDOT representative present.

The inspection can be conducted manually if adequate crawl/walking space and ventilation is available to safely conduct the inspection and the individual(s) conducting the inspection have undergone training on working in confined spaces in accordance with VDOT's current Safety Policy and Procedure #8 Confined Space Entry Policy and Procedure - General, or the inspection can be conducted with a video camera. If the inspection is to be conducted with a video camera, the video camera shall have fully articulating lenses that will provide a 360 degree inspection of the pipe/culvert, including each joint and any deficient areas of the pipe/culvert, as well as a means to measure deformations/deflections of the pipe (items such as a laser range finder or other appropriate device for taking such measurements as specified herein and approved by the Engineer).

If the inspection is conducted manually, the person performing the inspection may use a standard video camera or a digital camera to document any observed deficiencies. If the mandrel test is to be performed to mechanically measure deformations/deflections of the pipe/culvert, the mandrel used shall be a nine (or greater odd number) arm mandrel, and shall be sized and inspected by the Engineer prior to testing. The diameter of the mandrel at any point shall not be less than the allowable percent deflection of the certified actual mean diameter of the pipe or culvert being tested. The mandrel shall be fabricated of metal, fitted with pulling rings at each end, stamped or engraved on some segment other than a runner with the nominal pipe/culvert size and mandrel outside diameter. The mandrel shall be pulled through the pipe or culvert by hand with a rope or cable. Where applicable, pulleys may be incorporated into the system to change the direction of pull so that inspection personnel need not physically enter the pipe, culvert or manhole.

A copy of the Storm Sewer/Culvert Inspection Report (inspection report) including any video tape/Digital Video Recording (DVD)/digital photographs shall be provided to the VDOT Inspector within two business days of the completion of the inspection and made part of the project records. Additionally, a copy shall be furnished to local VDOT Asset Management personnel to document the pipe/culvert condition at that point in time. The video tape/DVD/digital photographs should be of such clarity, detail and resolution as to clearly show the conditions of the interior of the pipe/culvert and detect any defects within the pipe or culvert as specified herein. Post installation inspections shall be conducted no sooner than 30 days after completion of installation and placement of final cover (except for pavement structure).

## **PROCEDURES**

The post installation inspection shall be conducted in accordance with the requirements of Section 302.03(d) of the Road and Bridge Specifications and the instructions included herein. The inspection report shall identify the location of the pipe/culvert being inspected with respect to the project site. The inspection report shall identify the location of the inspection access point of the pipe/culvert being inspected with respect to the plans (e.g., north/south/east/west end of the pipe/culvert, manhole/drop inlet/junction box structure number, etc.). The location of any deficiencies within the pipe/culvert shall be noted in the inspection report by identifying the distance from the inspection access point. If no deficiencies are noted, an "OK" entry shall be made in the report under the remarks column for each section of pipe/culvert inspected.

Where deficiencies are found, a video recording is to be used to identify the deficiency in addition to it being noted on the report form. The video camera system shall be capable of capturing clear images. The camera system shall have a titler/keyboard for data entry and an audio microphone for verbal descriptions; both a textual note on the video/images and a verbal description shall be used to note deficiencies. The camera system shall have a locator system for locating the position of the camera, and a footage counter on the cable reel. The location and description of the deficiency should be added to the recording by the use of an audio microphone. When deficiencies are noted that require remedial actions, the contractor's proposed remediation measures shall be noted in the report form.

The Department shall review the post construction inspection report including any proposed remediation measures and communicate its findings to the Contractor within 10 days of receiving the report. Where the Department agrees with the proposed remediation measures, the contractor shall be notified of such approval and authorized to begin such work. Where the Department disagrees with the proposed remediation measures or where the Department identifies additional deficiencies that require remedial action, the contractor shall be notified of such findings and requested to submit a supplemental remediation plan. Pipes or culverts that required coating should have the coating inspected. Cracks (longitudinal and circumferential) shall be noted in the inspection report and photographed (if not videoed) and digitally scanned to allow for accurate measurement. Spalls and slabbing locations shall be photographed (or videoed) and noted in the report.

Upon completion of the corrective measures, the remedial locations are to be re-inspected prior to final acceptance of the project by the same test methods noted herein. Re-inspection shall be made within 10 days of correction except where sections of pipe/culvert have been replaced re-inspection shall not occur sooner than 30 days after replacement of pipe/culvert and final cover (except for pavement structure).

## **DEFICIENCIES**

Deficiencies may include, but are not limited to, the following:

1. Crushed, collapsed or deformed pipe/culvert or joints.
2. Alignment defects would include sags in the longitudinal profile and invert heaving.
3. Improper joints that can allow leaking of water or infiltration of backfill or surrounding soils.
4. Misaligned joints that can cause debris accumulation.
5. Pipe/culvert that has been penetrated by guardrail or other posts or improper backfill materials or methods.
6. Debris, construction or other materials in the pipe/culvert or structures.
7. Coating material shall be free of cracks, scratches and peeling.
8. Cracks (longitudinal and circumferential).
9. Spalls and slabbing.
10. For metallic and plastic pipes/culverts, localized buckling, bulging, cracking at bolt holes (metallic only), flattening, or racking, as well as the applicable points noted above.



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  $6 \pm 2$  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 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 pipes identified on the plans as storm sewer pipe and a selected number of pipe culverts. For the purposes of this Section all pipe installations not identified on the plans 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 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. 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.

- 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, 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 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:

<b>Amount of Deflection</b>	<b>Percent of Payment</b>
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 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:

<b>Amount of Deflection</b>	<b>Percent of Payment</b>
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.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Post installation inspection	Linear Foot