Video and Laser Measurement Tools

New Storm Pipe Installation Quality Assurance at Its Best

Over the past decade, the deteriorating state of our nation's infrastructure has gained increased attention. Great emphasis has been placed on the aging bridges of our nation's roadways due to several high profile catastrophic failures. Sadly, it took the death of several motorists to spur a public outcry to address the current state of despair of one our nation's most important infrastructure components.

Our roadway pipe systems demand this very same attention, since they are the "unseen" bridges of our nation's ground transportation systems. While we must address the existing aging system, to maximize the life of future installations we must act now to ensure quality installations are occurring.

It is apparent that we must fully address the importance of:

- Proper **INSPECTION** of all installations,
- Adequate design life,
- Conservative design approaches,
- Complete and stringent reviews of all critical construction components,
- Strong quality assurance programs throughout the construction process, and
- Diligent and proper maintenance of all the components of our roadway infrastructure.

This document focuses on the tools and current techniques of post installation inspection as they apply to underground storm culverts and sewer systems. Post Installation Inspection, (PII) is an important component of proper installation of storm piping infrastructure to ensure proper design life and safe operation of the roadway system it supports.

Inspection of underground piping systems is not a new concept. Over the past several decades, the sanitary sewer community has developed and improved the various inspection techniques for their piping systems. Visual inspections with camera and video systems have become common-place. Inspection tools were developed to confirm shape control of flexible pipe systems as those products were utilized for the sanitary sewer systems decades ago.

As more flexible products have entered the storm market, many owners have applied these same sanitary sewer inspection techniques to their post installation inspection strategies for storm culverts and sewers. Storm system owners have now recognized that the only way to ensure a product's service life is to verify that it has been designed and installed correctly. To do so, some type of post installation quality assurance must be performed to confirm the pipe system was not damaged during the construction phase of the project. Such damage could result in inadequate structural capacity, require excessive maintenance, alter the design flow or lead to unanticipated failures.

Many state DOTs and municipalities are implementing post installation quality assurance by requiring stringent post installation inspection of all or some portion of new storm water culvert and sewer systems that are installed.

RCP industry research in June of 2012 indicated that there are 33 DOTs currently, imposing some type of post installation inspection requirements. Two-thirds of the 33 DOTs have specific deflection limitations that include mandrel testing or some other type of measurement of flexible pipe systems, while the other 13 allowed or required more sophisticated post installation inspection techniques that include CCTV and high-tech measuring devices to confirm proper shape, joints, and internal wall conditions. In June of 2012, there were more DOT's and municipalities considering the adoption of CCTV inspections and robotic measuring devices to improve their post installation inspection criteria.

Stringent post installation quality assurance programs are win-win opportunities that benefit ALL of the stakeholders of a project.

- The **design engineer wins** because he can be confident that the installation standards have been followed and his design assumptions were correct, therefore reducing his future liability due to premature failure,

- The **installer wins** because his installation crew will take proper care in handling, storage, and installation processes. Any damage can, and will be, identified and properly evaluated and remediated if needed. The installer will know that when the project is completed, the pipe installations will be sound and the likelihood of future problems and liability for his company are greatly reduced,
- The **owner wins** because he obtains a trouble-free installation, he is assured the product service life will likely be met or exceeded, and the risk of an expensive failure is highly unlikely,
- **Pipe producers and suppliers win** by demonstrating quality, they will be assured that the products supplied will be installed correctly, and they will reduce liability due to unanticipated maintenance or failures,
- **The roadway user wins** because the products utilized will safely serve the traveling public throughout its intended service life, and
- The **nation's infrastructure wins** because roadways will be safer and fewer failures will reduce the impact on strained state and federal budgets .

ASTM & AASHTO Have Set the Standard:

For years, plastic pipe manufacturers have been telling the engineering community that "generally, no post construction inspection is necessary" [1] or "mandrels should be considered a last resort to evaluating the installation." [2] At the same time, ASTM D 2321, *Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications* includes a section that lists available deflection testing devices, including a properly sized "go, no-go" mandrel. The reality is that plastic pipe requires a combination of high quality soil materials and proper compaction to function structurally. Since plastic pipe is so highly dependent upon proper installation techniques, more and more specifications now mandate deflection testing and are insisting that the test be performed no earlier than 30 days after completion of installation.

In 2004, AASHTO leadership insisted that all of the AASHTO installation standards for the three major pipe systems utilized on DOT projects (RCP, CMP, plastic) include guidance on proper Post Installation Inspection for each of the pipe types. The resulting work from the AASHTO committees is summarized below:

AASHTO LRFD Bridge Construction Specifications for Post Installation Inspection

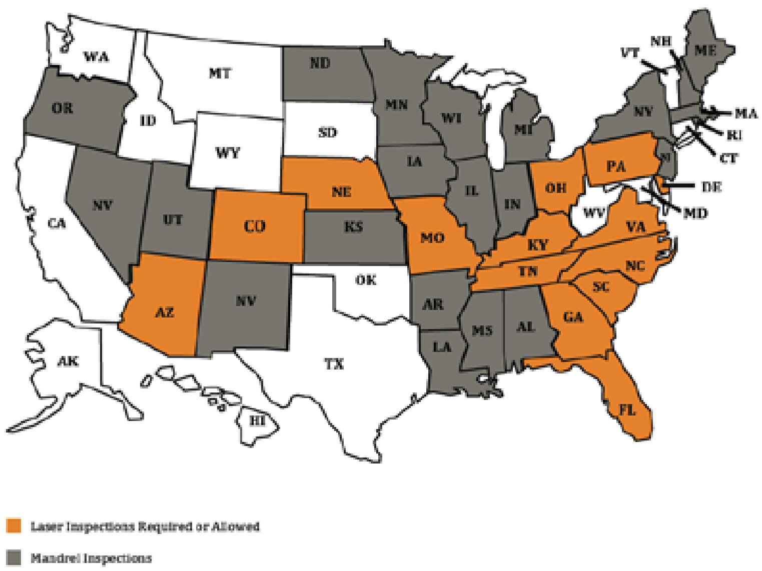
	RCP Section 27.6.1-9	**Metal Section 26.5.7.1-2**	**Plastic Section 30**
Visual Inspection	100%		
Final Inspection	No sooner than 30 days after the completion of installation and final fill		
Deflection Testing Totals	N/A	10% of all pipe runs, and total footage	10% of all pipe runs, and total footage
Deflection Testing Equipment	N/A	Video inspection and direct measure	Video inspection and direct measure
Defect Evaluation or Replacement Required	0.01" < Crack[1] < 0.10" Crack[2]	Denting, racking or shape damage when deflection < 7.5%	>5% nominal diameter deflection[3]
Defect Remediation or Replacement Required	Non-repairable defect	> 7.5% nominal diameter deflection	> 7.5% nominal diameter deflection

1. If pH<5.5 or detrimental, seal crack. Otherwise, OK. Evaluate misalignment, joints, cracks, spalling, and slabbing
2. if detrimental, seal crack. If not repairable, remediate or replace
3. If problematic, remediate or replace

Application of National Standards by DOT's and Municipalities:

Now that post installation requirements have been fully vetted at the national standard level we are seeing how system owners are utilizing the guidance in their own standards and specifications.

State DOT's and Provinces have already required deflection testing with specifications more restrictive than the recent AASHTO provisions. In the interest of brevity, all specifications requiring deflection testing cannot be listed. However, here are some selected cases. For more information on the full list please contact the American Concrete Pipe Association.



What's Prompting the Trend to the "New Tools"?

Pipeline laser profiling is rapidly becoming an economical and superior alternative to traditional video inspection of installed storm sewer and culvert pipe. Though the technology has been around for 10 to 15 years, recent developments in digital video analysis have made it a truly viable improvement over traditional video inspection and mandrel deflection testing.

When done in conjunction with traditional video inspection, laser profiling can be performed at a relatively small incremental cost. Compared to traditional mandrel testing and video inspection, laser profiling is very competitively priced, especially considering the wealth of information that is available by utilizing this technology.

As the video camera and laser ring move through the pipe simultaneously, the video image is recorded, and then processed to develop vast amounts of information that cannot be accurately discerned from traditional video inspection. The improved data can include: deflection, pipe ovality, corrugation depth, and pipe capacity. Some software even has the ability to create a fully interactive 3D model of the pipe.

Owners and specifiers can serve the end user by embracing the idea that all piping products must be selected, designed, installed, and inspected properly. Stringent Post Installation Inspection requirements are win-win propositions for all storm system stakeholders. The new CCTV and robotic measurement tools provide owners with the most accurate and complete picture of condition of newly installed piping culverts and storm systems.

References

1. 1. Implemented Modifications to the 2007 Standard Specification for Road and Bridge Construction, Subsection 430-4.8, Florida Department of Transportation, July 2008.

2. 1. Special Provision MA1010HDPEP, Subsection 1010-8.03, Arizona Department of Transportation, 24 July 2005.

3. 1. Supplemental Technical Specification SC-M-714, Subsection 3.3.10, South Carolina Department of Transportation, 2 September 2008.

4. 1. Supplemental Specifications to The Standard Specifications for Road and Bridge Construction, Subsection 701.04.07, Kentucky Transportation Cabinet, 29 August 2008.

5. 1. Kentucky Method 64-11-08, Kentucky Transportation Cabinet, 24 July 2008.

6. 1. Standard Specifications for Highway Construction, Subsection 719.03, Nebraska Department of Roads, 2007.

7. 1. Supplemental Specification 802, Subsection 802.12, Ohio Department of Transportation, 20 October 2008.

8. 1. Virginia Test Method 123, Virginia Department of Transportation, November 2008.

9. 1. Supplemental Specifications of the Standards for Road and Bridge Construction, Subsection 607.09, Tennessee Department of Transportation, 1 March 2006