Analyzing CCTV Inspection of Vitrified Clay Pipe

NCPI

NATIONAL CLAY PIPE INSTITUTE

The VCP Authority Since 1917

This Guide

The goal of this handbook is to serve the needs of CCTV camera operators and their utilities by providing clarity around common issues when using CCTV to inspect Vitrified Clay Pipe (VCP) lines. Each specific condition is highlighted on a separate page with an illustration of the condition and a CCTV image from inside the pipeline.

The assessment guidance presented in this handbook is reliable, but no guarantee is made, or liability assumed. Direction from this handbook should not be substituted for the judgment of a professional engineer, system owner, and/or operator experienced in evaluating CCTV footage of Vitrified Clay Pipe.

Three Keys to CCTV Inspection of VCP Lines:

- The image, as seen by the camera, may be distorted, exaggerating an area of concern. The operator's observations may not accurately portray conditions .... **Page 2**
- The image of a joint is exaggerated by the pipe trim/end chamfer, pipe roundness, and the designed gap between pipe ends. These visual anomalies do not affect the integrity of the joint. .... **Pages 5 and 14**
- Avoid misinterpretation of manufacturing and handling marks. They are not breaks or cracks........ **Page 18**

Acceptance Testing

The Low-Pressure Air Test is NCPI's recommended acceptance test. It is the definitive low-cost test for pipelines and can frequently prevent costly mistakes. It is a clear pass/fail test evaluating the structural soundness of all pipe sections and integrity of each compression joint.

Figure 1: A CCTV camera in an 8" pipe.
Photo courtesy of Plumbers Depot Inc.

Closed-circuit television (CCTV) inspection continues to gain acceptance as a means of investigating the condition of all types of buried assets. Widespread adoption of CCTV inspections has been driven by the high-quality video images and records these systems produce. As an investigative tool, CCTV systems are unmatched. Operators can highlight concerns and more importantly, the reports create historical records of the condition of pipe at the time of final acceptance. This visual record is an important reason for many agencies requiring CCTV inspection as a part of the final acceptance testing on newly installed pipelines.

> **Information from a variety of inspection tools should be used to make better decisions: CCTV is only one aspect of assessment and should not be used in isolation.**
>
> *– Condition Assessment of Wastewater Collection Systems, EPA/600/R-09/049 White Paper; Feeney, Thayer, Bonomo, Martel (2009)*

As valuable as a CCTV inspection can be, human and software errors can and have resulted in expensive and unnecessary "repair" projects. A Low-Pressure Air Test, per ASTM C828 (*Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines)*, provides an operational-based test of the full installation.

Operators and reviewers of CCTV footage are looking for problems. Erroneous CCTV reviews have led to decisions that become difficult to justify or explain. Some repairs based on guidance from video inspections have shown the problem described to either be non-existent or of significantly less magnitude than indicated.

Whenever there is doubt, operators should contact the pipe manufacturer for further review. To minimize the risk of misinterpretation, operators should be certified to use the specific software and hardware. For more information and a few examples of cosmetic imperfections in clay pipe, see pages 18 and 19.

***Figure 2:** The picture at left was the observed condition of an 8-inch pipe in a CCTV inspection. The photo at right is the recovered pipe that passed the air test. The cosmetic imperfection is well-within the chip allowance specified in ASTM C700 and would have had no impact on long-term performance. For more examples of cosmetic imperfections, see pages 18 & 19.*

To address some of these concerns, the National Clay Pipe Institute and Cues, Inc. worked together to update an earlier study exploring the actual versus perceived results of televised inspection. New equipment, better lighting and higher resolution viewing screens are just a few of the advances in equipment and tooling that made this update necessary. The plan was to revisit conditions that had previously proven to be problematic. It is by no means a full exploration of all issues that may be encountered. When in doubt, err on the side of caution, run a Low-Pressure Air Test and contact the pipe manufacturer.

For this study, 8-inch VCP pipe sections were setup in a laboratory in straight alignment and with known and measured instances of parallel offsets, pulled joints, joint sags, vertical/ horizontal joint deflection, service connections, and cosmetic imperfections. These sections were inspected using CCTV. The images were captured by a Cues, Inc. Digital Universal Camera (DUC) with 3.1-megapixel high-resolution camera and high output strobe lighting system.

Pre-CCTV Inspection Preparation

Inspectors and operators should be manufacturer-trained on the equipment and software of the CCTV system being used.

Knowledge of the Material Being Inspected

Of the various pipe materials found in sanitary sewers throughout the U.S., VCP will frequently be the oldest sewer pipe in a collection system. As a kiln-fired ceramic, VCP is a natural material with some dimensional and cosmetic variations being normal, such as the “lime pop” in the pictures on page 2. A small piece of lime may occasionally be close to the pipe surface after extrusion. During firing, this lime may “pop” and result in the marks seen in Figure 2 on page 2. These should not be regarded as a cause for rejection.

Dimensional tolerances and allowable cosmetic imperfections for VCP can be found in ASTM C700 (*Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated*) and ASTM C1208 (*Standard Specification for Vitrified Clay Pipe and Joints for Use in Microtunneling, Sliplining, Pipe Bursting, and Tunnels*).

Many municipalities in the U.S. still have pipe in-service that was installed in the 1800s. In the late nineteenth century there were hundreds of clay pipe manufacturers across the U.S. As a result, the pipe itself can vary in shades, glazing or various other cosmetic features. These variances should not be seen as areas of concern, especially in pipe installed prior to 1950.

As the joint cutaway photos on pages 5 and 6 (Figures 3, 4, 5 & 6) show, variations in color are still common, but no pipe currently manufactured in the U.S. is glazed.

Knowledge of the Jointing Systems

Probably the largest misconception about VCP surrounds the jointing system. Many people think of the early field-made tar joints from the 1800's and not the present day factory-made, flexible, compression joints that were first introduced in the late 1950s.

While cement mortar, oakum, and asphaltic joints are a thing of the past, there are many miles of pipelines with this type of joint system still in-service and conveying sewage on a daily basis.

The early versions of factory-applied, leak-free compression joints were put to the test in the San Fernando, CA earthquake of 1971. Following this earthquake, the City of Los Angeles and the ASCE (American Society of Civil Engineers) surveyed the pipe performance in the hardest-hit areas and noted that for all sizes of clay pipe, "...the flexible joint suffered significantly less percentage damage than the rigid joint pipe."

In the summary of their findings, the authors suggested: "The typical plastic compression joint could be modified to be more earthquake-resistant by placing a bead of the plastic material on the seat of the bell or on the spigot end to reduce damage due to hammering."

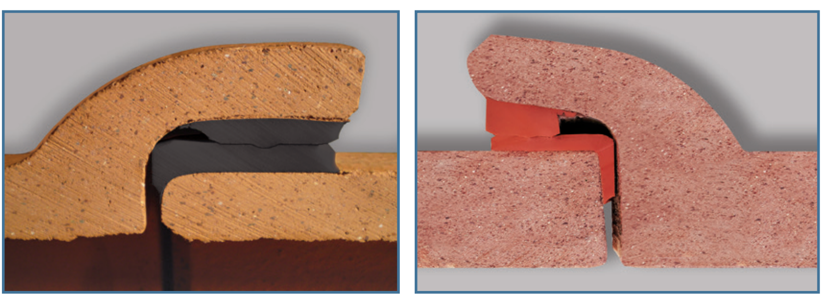


Figure 3: Vitrified Clay Pipe cross-sectional compression joint designs for Bell & Spigot pipe. Note the trim/ chamfer on the spigot and bell ends, as well as the "gap" on the fully homed joint.

Clay pipe manufacturers made a variety of adjustments to the original joints to address this recommendation, but the most important aspect of these was the "seismic cushion" as part of the spigot-end gasket. This design creates an intentional gap within the fully-homed joint assembly to allow for axial movement and prevent hammering. This flexible compression joint design encompasses a raised bead molded within the bell-end gasket to provide a connection that allows for angular deflection, shear load resistance, axial compression, and limited pullout (see Figure 3 on page 5). This became the first "seismic joint" design introduced to the industry.

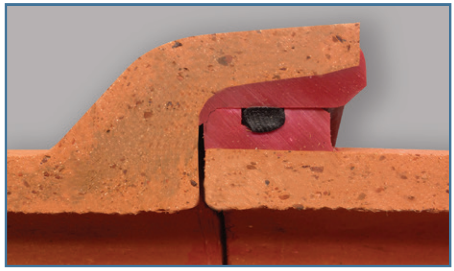


Figure 4: This joint design compresses a rubber O-ring between two dimensionally precise surfaces to achieve a water tight seal while allowing for normal amounts of angular deflection and shear load.

The flexibility designed into the joint allows for some angular deflection or offsets at the joint while the joint and the pipeline are functioning as intended. This flexibility at the joint is a design feature frequently used to create curvilinear sewer lines (For more information on Curvilinear sewers, see page 20).

Figure 5: Plain-end pipe with rubber compression couplings, internal shear ring, and stainless steel tightening bands.

As is apparent in the joint designs pictured in Figures 3, 4, 5 and 6 it is impossible to "over-home" a VCP joint.

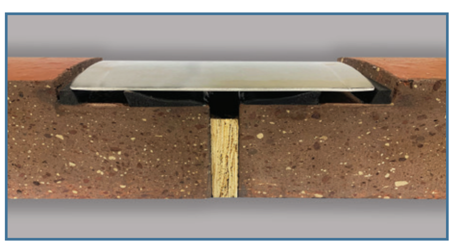


Figure 6: VCP jacking pipe joint.

Pipe and the jointing system are tested in the lab in accordance with ASTM C425 (*Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings*). These tests include angular deflection at the joint, an external load is applied and the pipe is filled with pressurized water. In order to pass this test there must be no leakage.

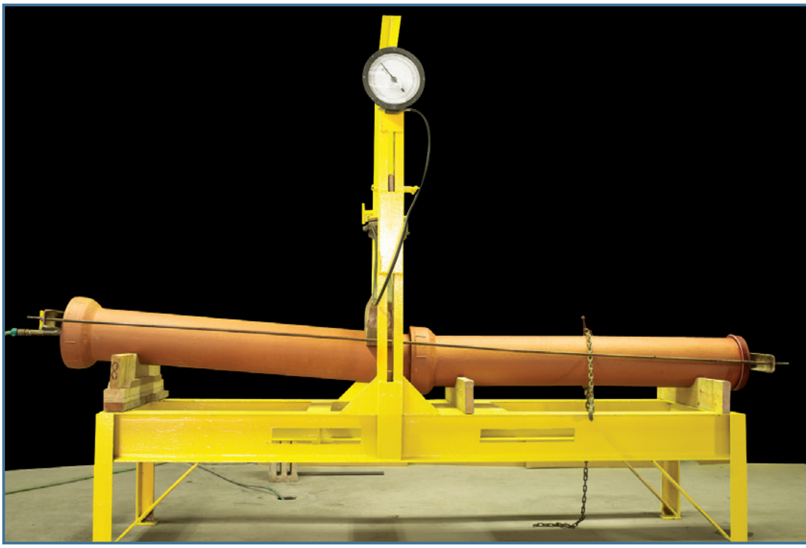


Figure 7: *8-inch Vitrified Clay Pipe laboratory testing with a vertical angular deflection at the joint of ½-inch per foot. VCP joints are required to pass this test with zero leakage.*

Figure 8: *21-inch VCP Jacking pipe passing the same test.*

Pipe Preparation

When a CCTV inspection is part of acceptance testing for a new installation, cleaning the line prior to inspection is strongly recommended to remove construction debris, cobwebs, bedding materials and other debris that can obscure defects.

Figure 9: The best long-term value is realized when crews are trained to take full advantage of the cleaning options that are only available in VCP systems.

When using CCTV for assessment of existing pipelines in service, it is necessary to clean the pipeline immediately prior to inspection. The National Clay Pipe Institute recommends following cleaning procedures outlined in ASTM C1920 *(Standard Practice for Cleaning of Vitrified Clay Sanitary Sewer Pipelines)* or the NCPI Operations & Maintenance Handbook. The handbook is available on the NCPI website at ncpi.org.

When cleaning any sewer line, it is important for the crew to know the type of pipe material(s) prior to cleaning method and tool selection. Flexible thermoplastic pipe materials will significantly limit the cleaning tool options if any sectional lengths are present within the line to be cleaned. Pipe wall damage and/or structural failure to thermoplastic pipe materials can occur when using tooling intended for abrasion resistant non-deflectable pipe materials. These pipe types will not stand up to the hydro jetting pressures and mechanical cleaning methods that are commonly used in VCP pipelines.

Following the cleaning, it is important for the CCTV operator, inspector, and/or reviewer to understand the differences between pipe materials being inspected.

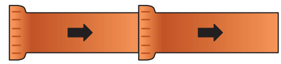
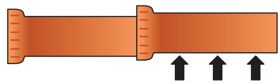
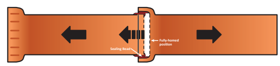
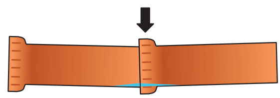
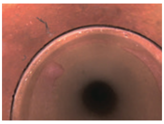
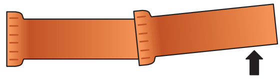
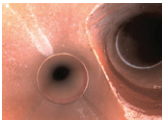
Before the first observation is made, it is important that the operator and reviewer fully understand the operation and capabilities of the equipment as well as the pipe material and joint design to be inspected. (See figures 3, 4, 5 and 6 on pages 5 and 6 showing joint designs currently in use).

Today's television equipment offers high resolution and the flexibility to view conditions at all angles. To reduce the distortion that can be caused by wide-angle lenses, the camera must be kept as near to the centerline of the pipe as possible. Maintaining camera alignment with the pipe is also critical in achieving accuracy when recording pipe conditions. Observations can be distorted by the camera lens, light intensity and a change in camera alignment.

Figure 10: Operations and maintenance staff should be trained in various options for installing laterals and repairing lines.

Keep in mind that what you see may be exaggerated in size and scope. Comprehensive operator training on the operation of the CCTV equipment and software is critical. This training helps to eliminate unnecessary and costly dig-ups.

Conditions Outlined in this Handbook

- Straight Alignment  (page 11)
- Parallel Offsets (Steps)  (page 13)
- Pulled Joints  (page 14)
- Joint Sags / Bellies  (page 16)
- Cosmetic Imperfections  (page 18)
- Angular Deflection / Curvilinear Sewers  (page 20)
- Laterals / Service Connections  (page 22)

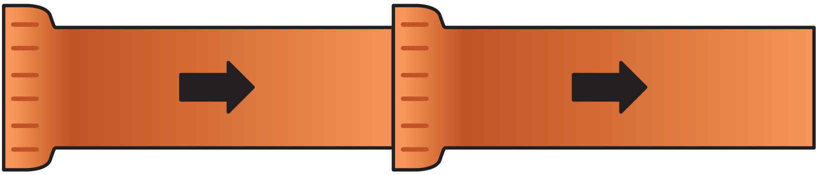


Figure 11: Straight alignment is generally the most common condition.

The camera is not looking at the end of the pipe as it may appear, but at the trimmed/ chamfered edge of the pipe giving a halo effect. The pipe in the photos are in straight alignment. However, because the camera is looking into the bell end of the pipe, it may create an illusion of an offset, deflected or pulled joint. This illuminated halo can lead operators to incorrectly code this condition as a parallel offset or even a pulled joint.

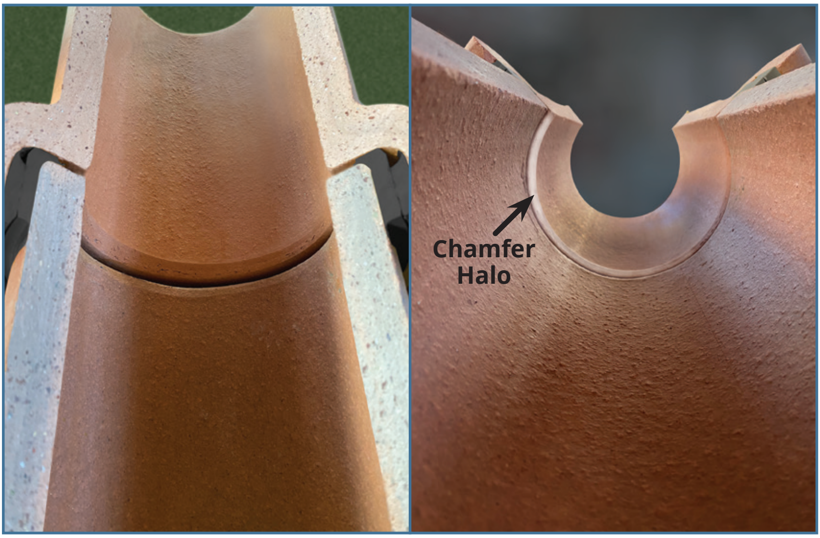


Figure 12: Both photos above are of the same joint cross section. The image on the left shows that it is fully-homed and sealed. This same joint, viewed from the angle of a CCTV camera, (right image) shows how the gap from the seismic cushion in combination with the chamfer can reflect the light from the camera creating a halo.

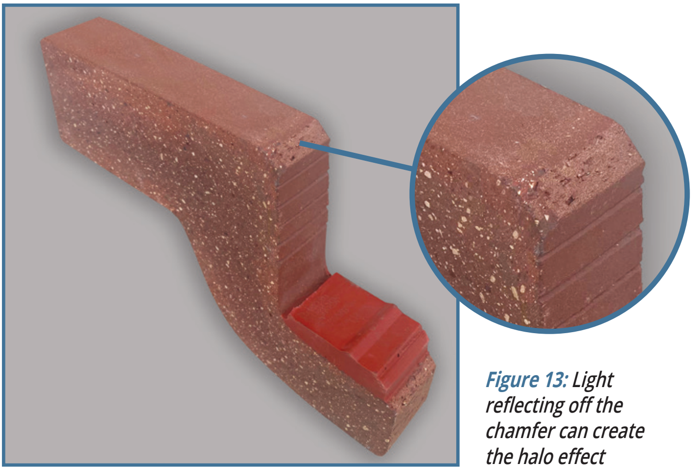


Figure 13: Light reflecting off the chamfer can create the halo effect

Also, the factory trimmed ends of the pipe (as shown in Figure 14) may not be perfectly concentric with the pipe presenting the illusion of an offset joint. The two images shown below are of a fully homed joint connection with no gap or offset.

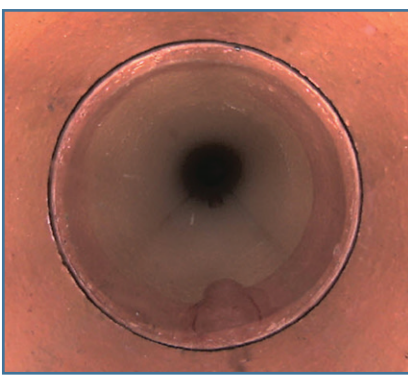


Figure 14: Straight Alignment – approaching

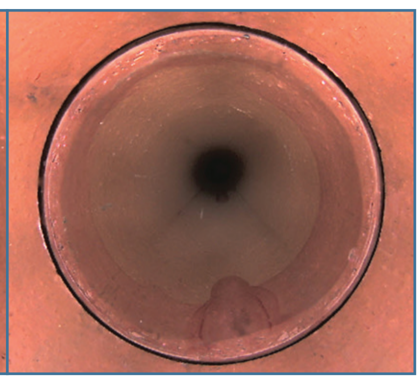


Figure 15: Straight Alignment – close-up

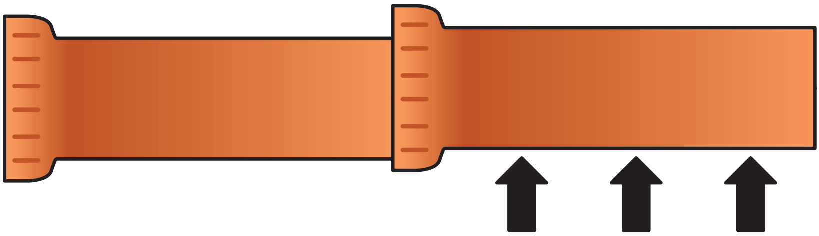


Figure 16: Joint offsets can occur during construction. If they are within allowable tolerances, they will not affect the performance of the pipeline.

Joint offsets during construction must be kept within allowable tolerances. Differences in roundness and dimensional inside diameter should be within tolerances for the pipe as specified in ASTM C700 and ASTM C1208. These variations should not be considered a parallel joint offset. Joint end trim may give the illusion of a parallel offset. Note the distortion of these minor offsets as they may appear much larger than actual. Observe the camera as it moves over the joint. If the camera tilts up or down this gives some indication of the magnitude of any offset.

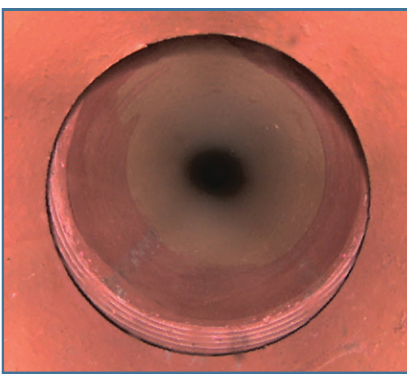


***Figure 17:* 5/8-inch Parallel Offset**
Bell/Spigot gaskets removed for illustration purposes

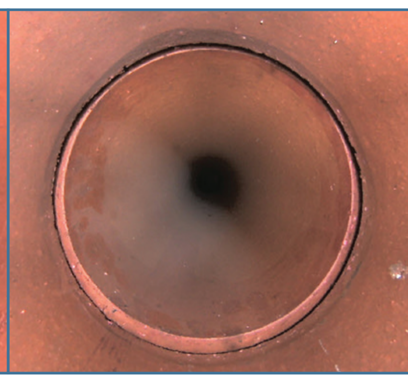


***Figure 18:* 3/8-inch Parallel Offset**
Bell/Spigot gaskets poured non-concentric for illustration purposes

If an offset is within ASTM standards or if it passes a Low-Pressure Air Test, it will not effect the performance of the pipeline or the integrity of the pipe.

Pulled Joints (GAPS – Installation Anomaly)

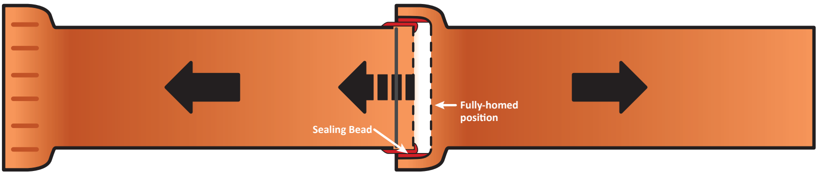


Figure 19: Pulled joints can occur when trench boxes are moved without enough care.

During construction, joints must be assembled to assure pipeline integrity. When using a trench box, pipe must be held in place when the box is moved forward to ensure the assembled joint does not pull apart. If joints have been pulled, a larger gap may result between the pipe ends. The joint design for clay pipe provides an allowance for joint gap without sacrificing pipeline integrity, see Figures 19 & 20.

Assembled joints that are fully homed may have a tight fit at one location while showing a minor gap at another. This is not a pulled joint if the sectional lengths are within end squareness tolerances as specified in ASTM C700. For more information on this condition, see Curvilinear Sewers on page 20.

Figure 20: While this joint cutaway shows a significant gap in the pulled joint for illustration purposes, the joint holds and would perform as specified.

The images below show a 3/8-inch and a 1-inch joint gap as viewed with the CCTV camera. Both joints passed a Low-Pressure Air Test to verify joint integrity.

Whenever there is doubt about the integrity of the joint seal, the Low-Pressure Air Test is recommended. If the installation passes the Low-Pressure Air Test, pipeline performance and pipe integrity should be unaffected.

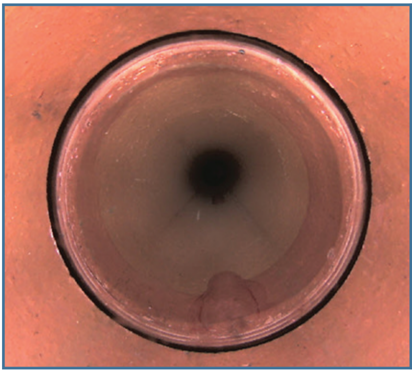


Figure 21: *3/8-inch Pulled Joint (gap)*

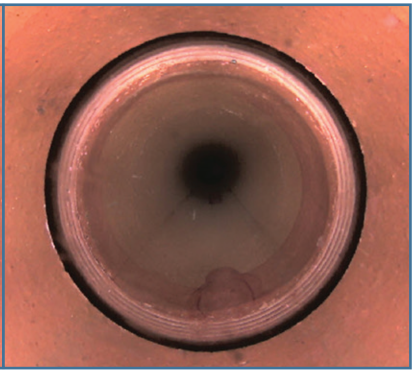


Figure 22: *1-inch Pulled Joint (gap)*

Joint Sags/Bellies

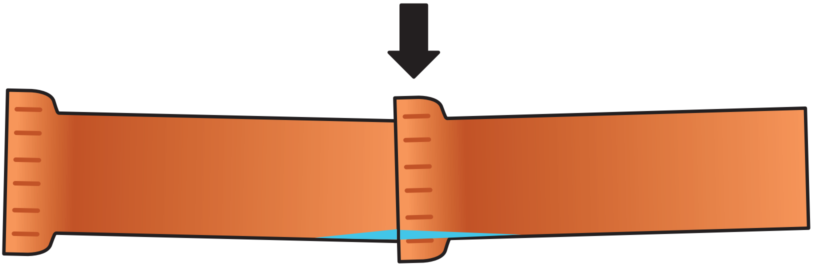


Figure 23: Joint sags are sometimes intentional (as in the case of siphons) and sometimes they occur due to post-construction settlement.

Any pipe can experience some settlement under load which may be due to insufficient bedding/ haunching, foundation support or other issues and not the pipe itself. If the settlement occurs at the joint, this is called a pipe sag. A minor joint sag may not affect the performance of the pipeline. After cleaning, water may remain in the line for a period where the line is at a flat grade. It may take a day or more for the water to completely drain and fully expose low points in the line.

Sags can be an intentional design feature such as in areas where siphons are constructed.

Pipe bellies differ from joint sags as they do not extend across the joint into the next pipe section. In pipe bellies, the water depth starts and stops within one length of pipe.

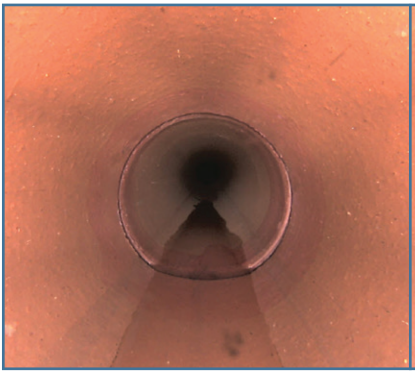


Figure 24: ½-inch water depth

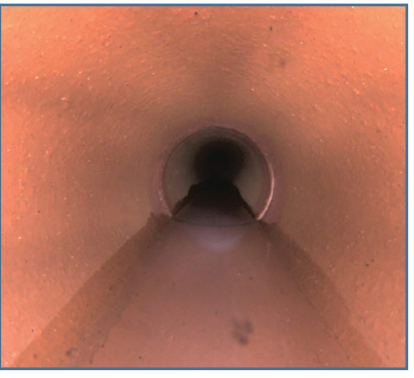


Figure 25: 1½-inch water depth

Where sags occur, estimating the depth of the water is very difficult. This can be an issue no matter what pipe material is being inspected. If viewing video with no dimensional reference point, scale the available dimensions from the screen and apply basic geometry. An illustration of applying this method in an 8-inch pipe is seen in the *Estimating Depth of Flow* chart in Figure 26 below.

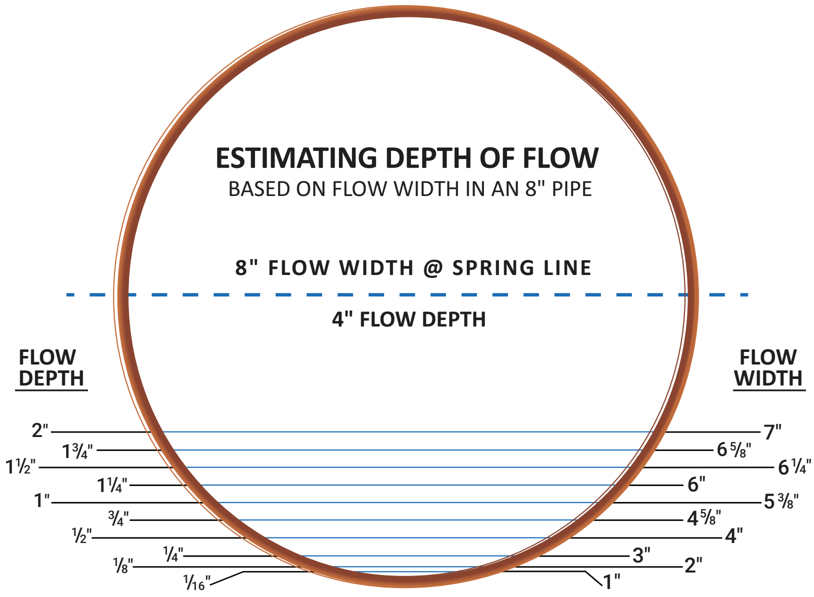


Figure 26: *In any pipe material, even a minor depth of water can appear exaggerated due to the optical illusion created by the periphery of the pipe.*

Cosmetic Imperfections

Be very careful in identifying breaks, fractures or cracks. Marks on the inside of the pipe may only be cosmetic imperfections on the inside surface. These marks are commonly caused by handling with a forklift, residual water lines from cleaning, or sewage flow marks. These have, on occasion, been mistaken for cracks or fractures.

Figure 27: Cosmetic Imperfection (caused by extrusion marks)

A crack will always start at the end of the pipe section and can be confirmed with a Low-Pressure Air Test of the line or can be seen via CCTV with water seepage marks.

Figure 28 shows a piece of excess clay that fell from the pipe end trimmer/ finisher and was stuck/ pressed to the inside of the 6-inch pipe wall. This happened after the pipe was extruded and before it was kiln fired. After firing it was permanently bonded.

The thickness is less than $^1/_{16}$-inch but the lighting and the camera really exaggerates the blemish as it wasn't noticeable with the naked eye.

Figure 28: Surface imperfection created during extrusion

Figure 29 shows polyurethane material that ran down inside the pipe when the bell gasket was poured during manufacturing. Each pipe section stands on end vertically while the bell gaskets are poured within a mold inside the pipe bell. This material spill was missed and didn't get cleaned off before the pipe was shipped, installed and inspected.

Crazing (also referred to as surface shrinkage, surface checking, firing checks or drying checks) is a common manufacturing condition on the surface of the pipe. This can occur on the inside surface of the barrel during the trim/chamfer process or on the outside of the barrel where the bell meets the body of the pipe. It does not affect the performance of the pipe in any way.

Figure 29: CCTV image of polyurethane gasket overpour

Crazing is a surface blemish that can occur anywhere on the pipe surface. It can be highly exaggerated by the CCTV light source and camera magnification during inspection.

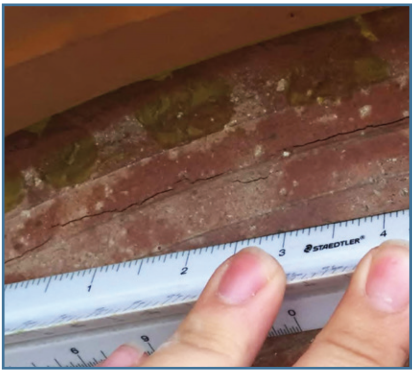


Figure 30: Crazing (pictured here) is common,but it has also been misidentified as a fracture or crack.

All of these conditions are cosmetic imperfections and will not affect the performance or integrity of the pipeline or joint system. Fractures as compared to cosmetic imperfections, go all the way through the pipe wall. They will almost always start at one end of a pipe section.

If there are any questions about possible cosmetic imperfections, please contact the pipe manufacturer or conduct a Low-Pressure Air Test.

Angular Deflection/Curvilinear Sewers

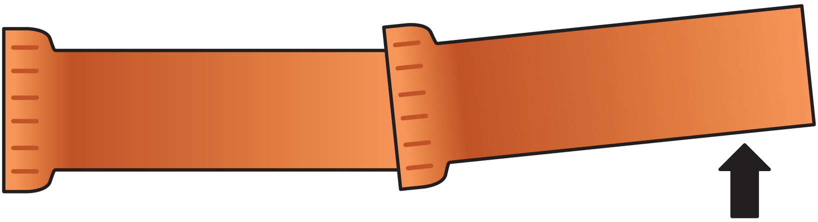


Figure 31: Angular deflection of joints along the pipeline can be intentional to create a curvilinear sewer. Modern VCP joints will maintain the specified leak-free performance.

The factory-applied joints of modern VCP pipe are designed to allow angular deflection while maintaining joint integrity (see the joint cutaway images on page 5 and 6). ASTM C425 (*Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings*) requires clay pipe joints to seal in angular deflection up to specified limits depending upon the pipe diameter (see the testing photos on page 7).

Figure 32: Installation of a curvilinear sewer

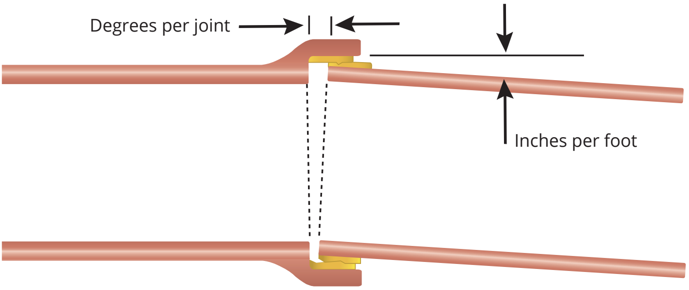


Figure 33: Cross-sectional plan view of an assembled joint in a curvilinear sewer. Note the design measurements and the intentional gap created at the outside radius of the curve.

Curvilinear sewers are designed using this angular deflection. Although there will be an apparent gap on one side due to the angular deflection, the joint is completely tight. See the photo below from inside the pipe to note the appearance of this condition.

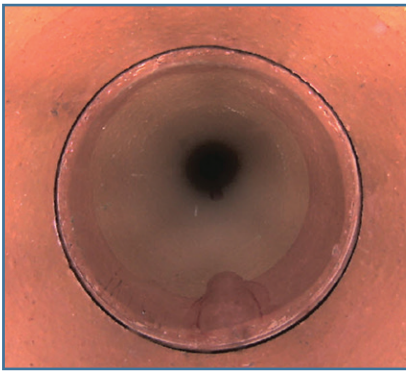


Figure 34: Vertical Angular Deflection
½-inch per foot (Section pulled up)

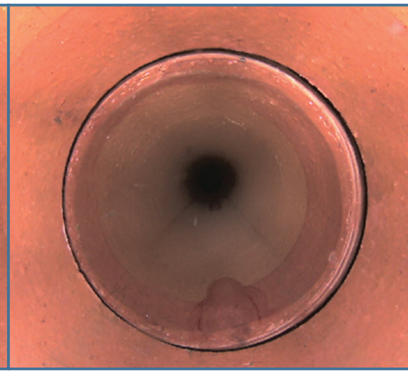


Figure 35: Horizontal Angular Deflection
½-inch per foot (Section pulled to the left)

Angular deflection can be used as an intentional design option to create a curvilinear pipeline. When used within ASTM limits, it does not affect the performance of the pipeline or integrity of the pipe.

RADIUS OF CURVATURE & ANGLE OF DEFLECTION

Pipe Diameter (inches)	Maximum Deflection		Values for r*	Minimum Radius of Curvature (r*)			
	In./LF	Angle Θ		Pipe Length L (feet)			
				4	6	8	10
3 – 12	1/2	(2.4°)	r = 24(L)	96	144	192	----
15 – 24	3/8	(1.8°)	r = 32(L)	128	192	256	320
27 – 36	1/4	(1.2°)	r = 48(L)	192	288	384	480
39 – 42	3/16	(0.9°)	r = 64(L)	256	384	512	640
48	1/8	(0.6°)	r = 96(L)	384	576	768	960

* r = Minimum radius in feet for the equation: $r = (360°/\theta)(L/2\pi)$

Table 1: Radius of Curvature & Angle of Deflection. For more detail, see the Engineering Manual.

Laterals / Service Connections

The camera in the mainline provides a partial view of the joint connection at the Y-branch spur and the curve for a service connection. Two images were captured using an 8x6-inch wye branch and a 30° curve. The first image shows a tight and square joint connection and the second has a ¾-inch gap. While the measured gaps are significantly different, they appear the same in the CCTV image from the mainline. Because of this visual similarity, an assessment cannot be made for the lateral connection via CCTV inspection from within the sewer mainline.

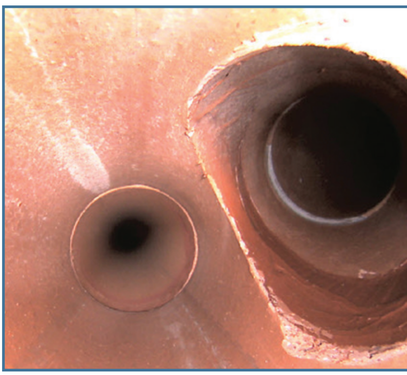


Figure 36: ***Wye Branch connection at 30° curve:*** *Zero angular deflection and no gap*

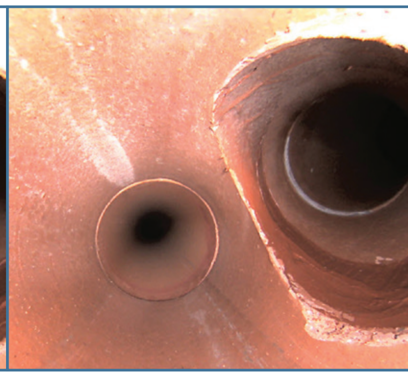


Figure 37: ***Wye Branch connection at 30° curve:*** *Maximum angular deflection and 3/4-inch gap*

Summary

Condition assessment of existing and newly installed sewer pipelines is necessary to ensure the integrity of a collection system. The data gathered as part of any condition assessment is also an important tool for the management of planning and operations.

The two most common methods of inspecting VCP are Low-Pressure Air Testing and Closed-Circuit Television (CCTV) inspection. The Low-Pressure Air Test evaluates the integrity of the entire installation while CCTV inspection only allows for visual inspection of pipe conditions. Many agencies incorporate CCTV inspection in conjunction with air testing as part of final acceptance. These reports create a historical record of the condition of the pipe at the time of final acceptance and over the life of the collection pipeline asset as regular maintenance and inspections are conducted.

Key points from this Handbook

- The operator's observations may not accurately portray the actual condition.
- The image, as seen by the camera, may be distorted.
- The camera position may affect the distortion. Center the camera in the pipe and make sure the camera is level with the pipe.
- It is difficult to determine specific dimensions because of the exaggerated view.
- The image of a joint is exaggerated by the pipe trim/ end chamfer, gap between pipe ends and the angle of the joint.
- Manufacturing and handling marks may be misinterpreted as breaks or cracks.
- Per the recommendation of ASTM C828 and municipal standards, a Low-Pressure Air Test should also be performed to confirm pipeline integrity. It is the definitive, low-cost test for pipelines including quality of the joint and can frequently prevent costly mistakes.

Recommendations

Know the materials, joint design, pipe and common conditions for the pipeline being inspected. It is essential that CCTV operators and data reviewers receive ongoing training on the equipment, condition assessment methods and characteristics of the pipe material evaluated to minimize errors.

Over-reliance on non-VCP specific guidelines and/or generic software may result in erroneous assessment of pipeline conditions.

There have been cases in which repairs were conducted only to discover the assessment did not match actual pipe conditions, or they were far less significant than originally indicated.

As a world-wide leader in developing and evaluating wastewater pipeline condition assessment, NCPI recommends the Low-Pressure Air Test as the preferred method of acceptance testing of a new pipeline installation.

ASTM Standards Referenced in this Handbook

ASTM C425	*Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings*
ASTM C700	*Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated*
ASTM C828	*Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines*
ASTM C1208	*Standard Specification for Vitrified Clay Pipe and Joints for Use in Microtunneling, Sliplining, Pipe Bursting, and Tunnels*
ASTM C1920	*Standard Practice for Cleaning of Vitrified Clay Sanitary Sewer Pipelines*

Our Member Companies

For specific questions about your project, please contact your pipe supplier.

MISSION
mission clay products LLC
missionclay.com
951-277-4600

GLADDING, McBEAN
Clay Tiles • Terra Cotta • Pottery • Pipe
gladdingmcbean.com
800-776-1133

LOGAN
Today's Clay Pipe
loganclaypipe.com
800-848-2141

building products company llc
buildingproductscompany.com
602-269-8314

NO-DIG
no-dig-pipe.com
740-385-2184

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Educational Opportunities

NCPI offers the tools and training to ensure successful design, installation and long-term performance of vitrified clay pipe as part of your sanitary sewer system. Properly designed, installed and maintained, VCP lines will serve the community for hundreds of years.

National Clay Pipe Institute's YouTube Channel

Available videos range from the manufacture of VCP to installation, and from various cleaning methods, and inspections to a recent tradeshow. Visit us at: youtube.com/c/NationalClayPipeInst

Educational Workshops (in-person or virtual)

NCPI offers a variety of workshops at no charge to engineers, designers, contractors, installers, inspectors, operations and maintenance personnel. We want to ensure your long-term success using VCP. Some of our popular workshop modules include:

- Manufacturing and Testing
- Gravity Sanitary Sewer Pipe Material Comparison
- Operations, Maintenance and Field Training
- Trenchless Technologies

Workshops qualify for PDH credits.

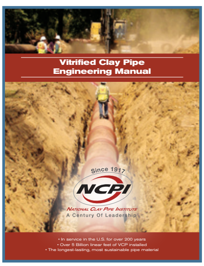
For more information, or to schedule your free workshop, contact one of our member-companies, the NCPI office at 262-742-2904, or email us at info@ncpi.org.

Popular NCPI Publications

All NCPI publications are available from our member companies or as a free download on ncpi.org.

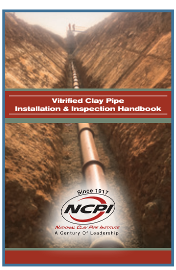
Low-Pressure Air Test Handbook

The Low-Pressure Air Test is the preferred method of testing pipe joints and sewer line installation. This test is used for line acceptance or leak location. The Handbook includes charts for time specifications for pressure drops based on pipe diameter and length of run tested.



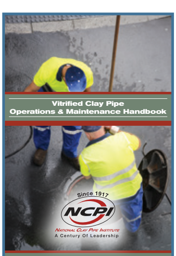
VCP Engineering Manual

A design and installation guide for VCP applications.



VCP Installation & Inspection Handbook

A compact, but thorough guide designed to be used at the jobsite.



VCP Operations & Maintenance Handbook

A comprehensive guide to cleaning and maintaining VCP sewer lines.

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