Fundamentals of MUNICIPAL GROUTING

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Presented by:

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3 Statements, only 1 Response

- You have personal experience with injection grouting?
- You have a negative perception of injection grouting?
- You have limited knowledge, anxious to know more?


interactive


engage™

INTRODUCTIONS

- Your name
- Your company
- Your role

INTRODUCTIONS

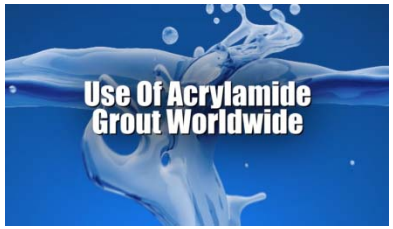
- Your name
- Your company
- Your role
- What are you famous for?


History Of Sewers


Consequences Of Infiltration


Test, Seal, & Validate


How Acrylamide Grouting Works


Use Of Acrylamide
Grout Worldwide


Grout Truck Overview


Process Of Sealing Mainlines


Mainline Packer Details


Process Of Sealing
Laterals From Mainline


Lateral Packer Details


Complimentary Technology

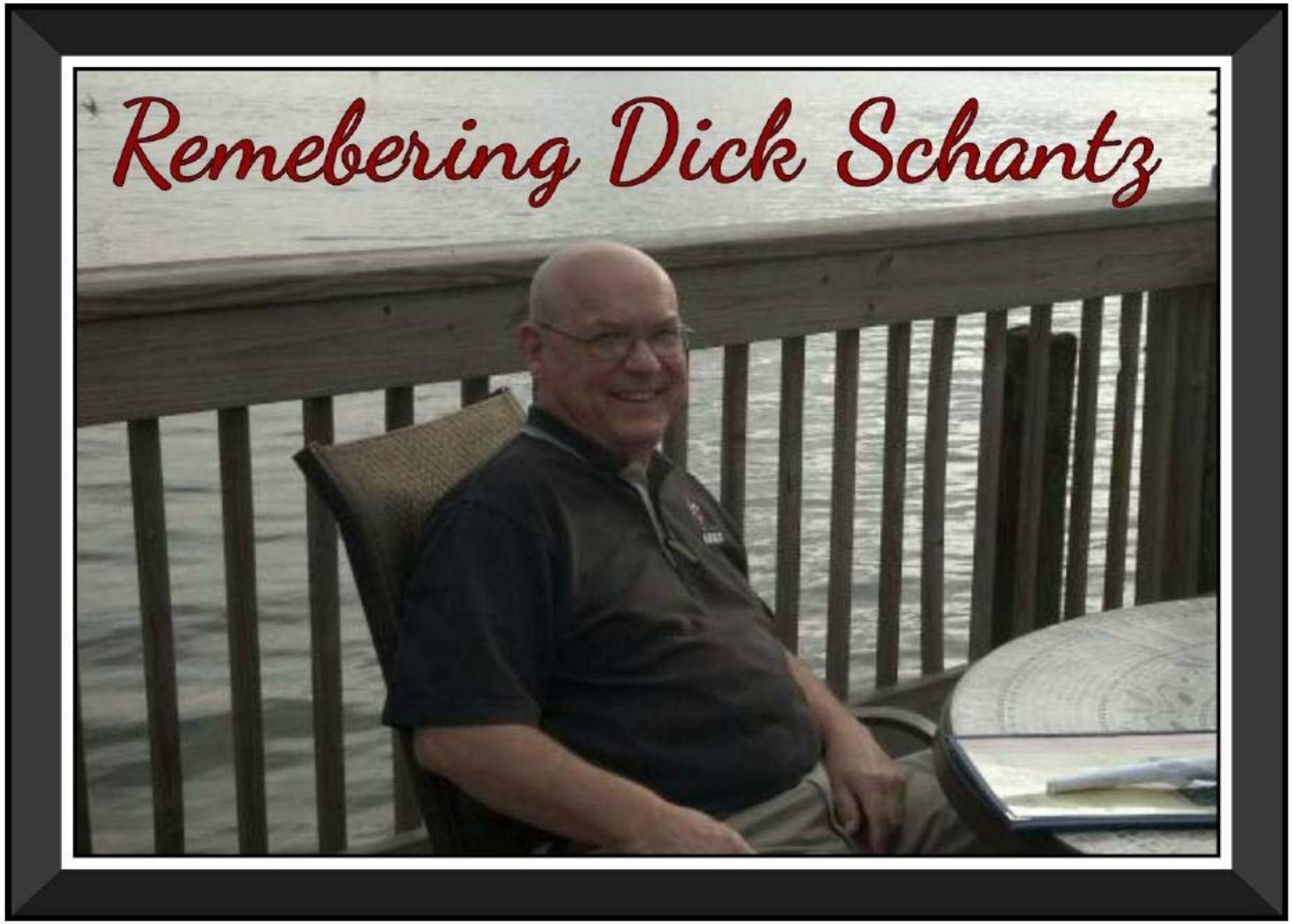

Techniques for Sealing Manholes


Chemical Mixing


Gel Strength


Chemical Safety


Standard Specifications


Remebering Dick Schantz

Richard (Dick) Schantz

Oct 11 1942-
Sep 6 2014

Why this course is important

How does injection grouting stop infiltration

How can this technology help me solve my issues

Holistic approach for best long term Infiltration reduction results

Working with complimentary technologies

Importance of standards & inspection for log term success

Best Return on Investment

Follow up

IMAGES PLEASE

History of Sewers

What to expect in Module 1:

- Water systems through the years – Roman Empire to Present
- Joint failure is a common characteristic in collections systems
- Understanding the collection system we inherited


History Of Sewers

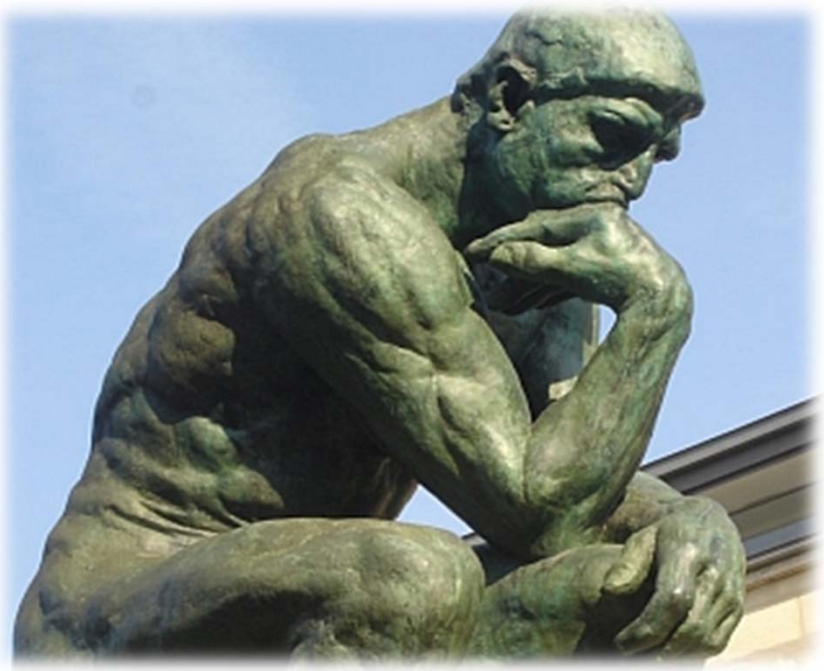
History of Sewers
Module 1

THIS IS THE INFRASTRUCTURE WE INHERITED

THIS IS THE INFRASTRUCTURE WE INHERITED

What's our morale obligation to future generations?

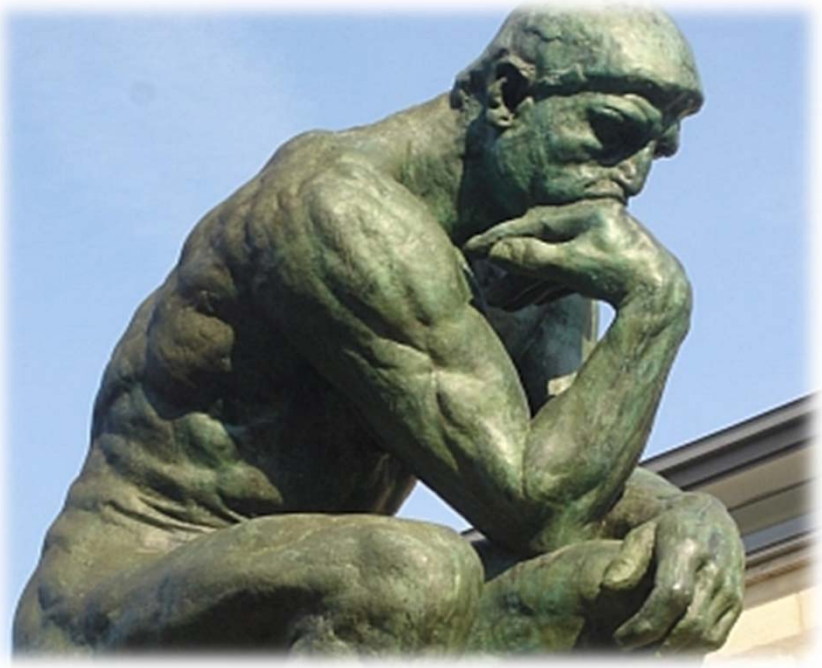
Remediation Technologies



How can I get the most for my money?

- Dig and Replace
- Fold and Form
- Sectional Lining
- Pipe Bursting
- Slip Lining
- Cure-in-Place Pipe

Remediation Technologies



How can I get the most for my money?

- Dig and Replace
- Fold and Form
- Sectional Lining
- Pipe Bursting
- Slip Lining
- Cure-in-Place Pipe
- Injection Grouting

Municipal Grouting

- **1st Decade—Exploratory**
  - Early Pioneers—mid1960's
  - Inventive
  - Tech Advancements
    - CCTV
    - PUMPS
    - PACKERS
    - GROUT CHEMISTRY

Municipal Grouting

- 1st Decade—Exploratory
- **Next 3 Decades—WWW**
  - No Standards
  - Contractor-Driven
  - Inconsistent Successes
  - Current Opinions & Beliefs

Municipal Grouting

- 1st Decade—Exploratory
- Next 3 Decades—West
- **Last Decade—Standards**
  - ASTM Performance Standards
  - NASSCO/ICGA Operating Standard
  - Multi-vendor Education

Municipal Grouting

- 1st Decade—Exploratory
- Next 3 Decades—West
- Last Decade—Standards
- **This Decade—Quality**
  - Grouting Community
  - Advances in Science
  - Contractor Qualifications
  - Value Engineering


Who
Is Your
Enemy?

INFILTRATION

Consequences of Infiltration

What to expect in Module 2:

- How storm water events impact our Waste Water Treatment Plants
- Understanding the hydraulics of the sewer collection system
- Why service laterals have questionable integrity


Consequences Of Infiltration

Consequences of Infiltration
Module 2

Infiltration vs. Inflow (I&I)

What is the difference between Infiltration and Inflow?

Infiltration is groundwater which enters the sewer collection system (pipelines and manholes) through defects in the sewer system.

Inflow is defined as surface water entering the sewer via flooded sewer vents, leaky manholes, storm drains, basement drains and by means other than groundwater.

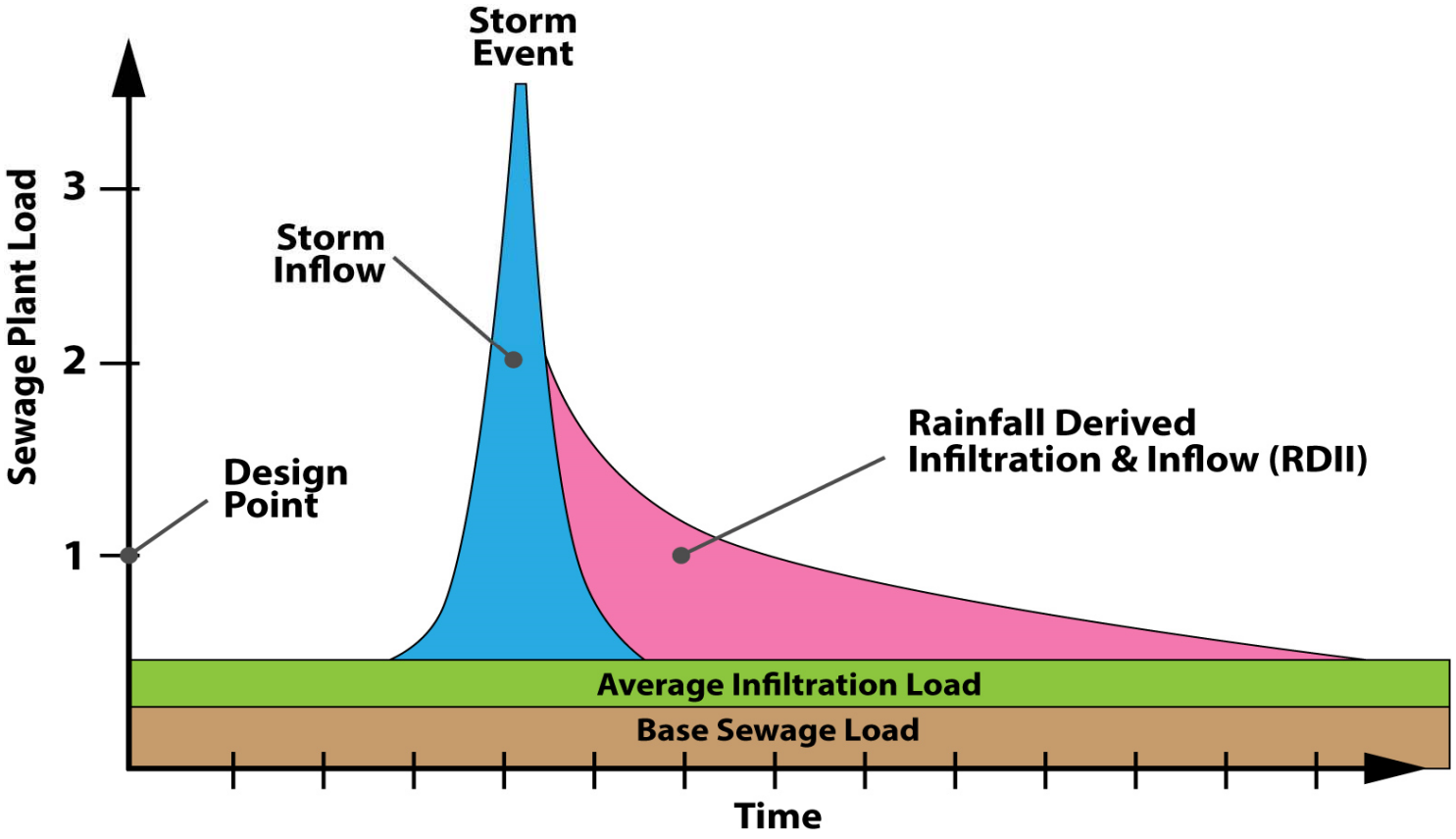
The Problem with I&I

"According to the EPA estimates, infiltration and inflow represent almost half of all flow at treatment plants nationwide. Infiltration and inflow (I/I) is a huge problem, and it only worsens over time if it is not addressed."

United States Environmental Protection Agency; Office of Research and Development, Washington DC 20460

EPA/625/R-961007 September 1996

Simplified Sewage Treatment Plant Loading Scenario

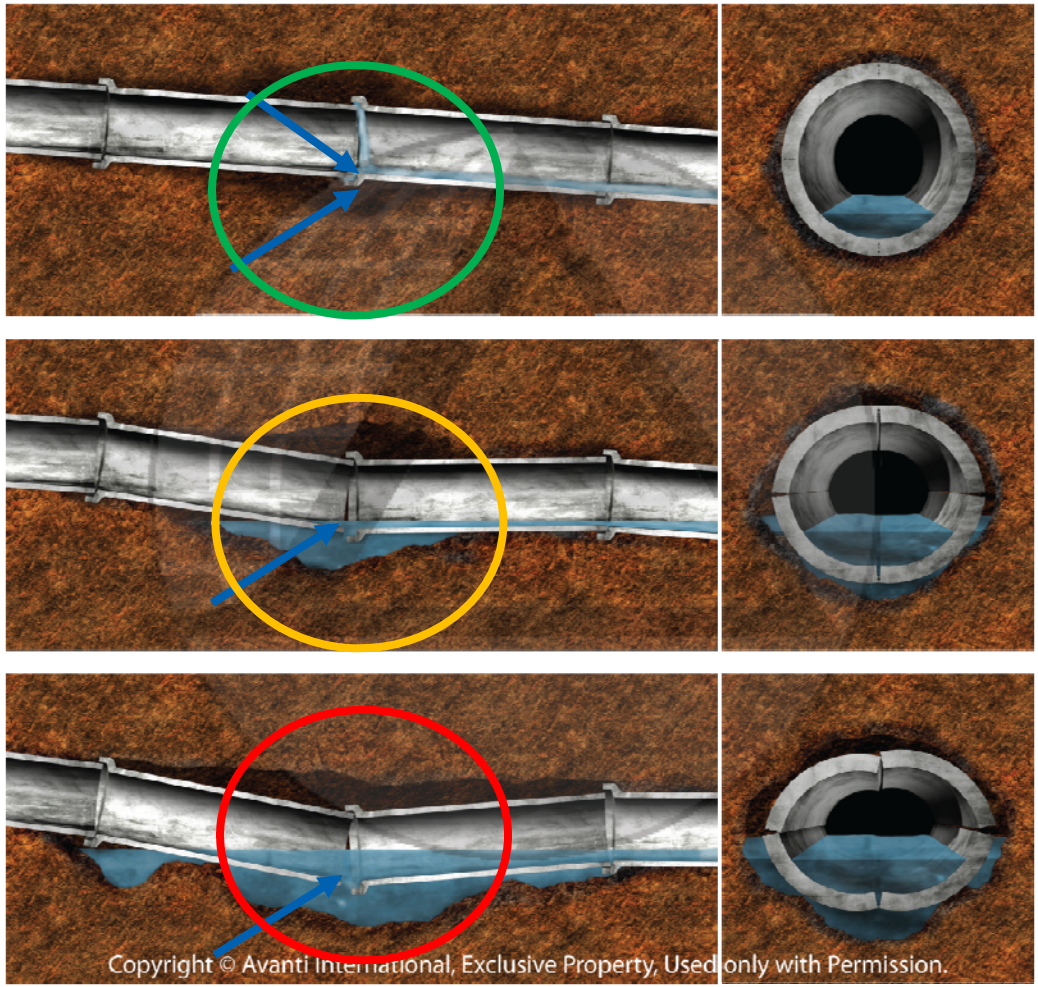


The Process of Sewer Failure

Stage 1: Initial defect, but sewer remains held in position by the surrounding soil.

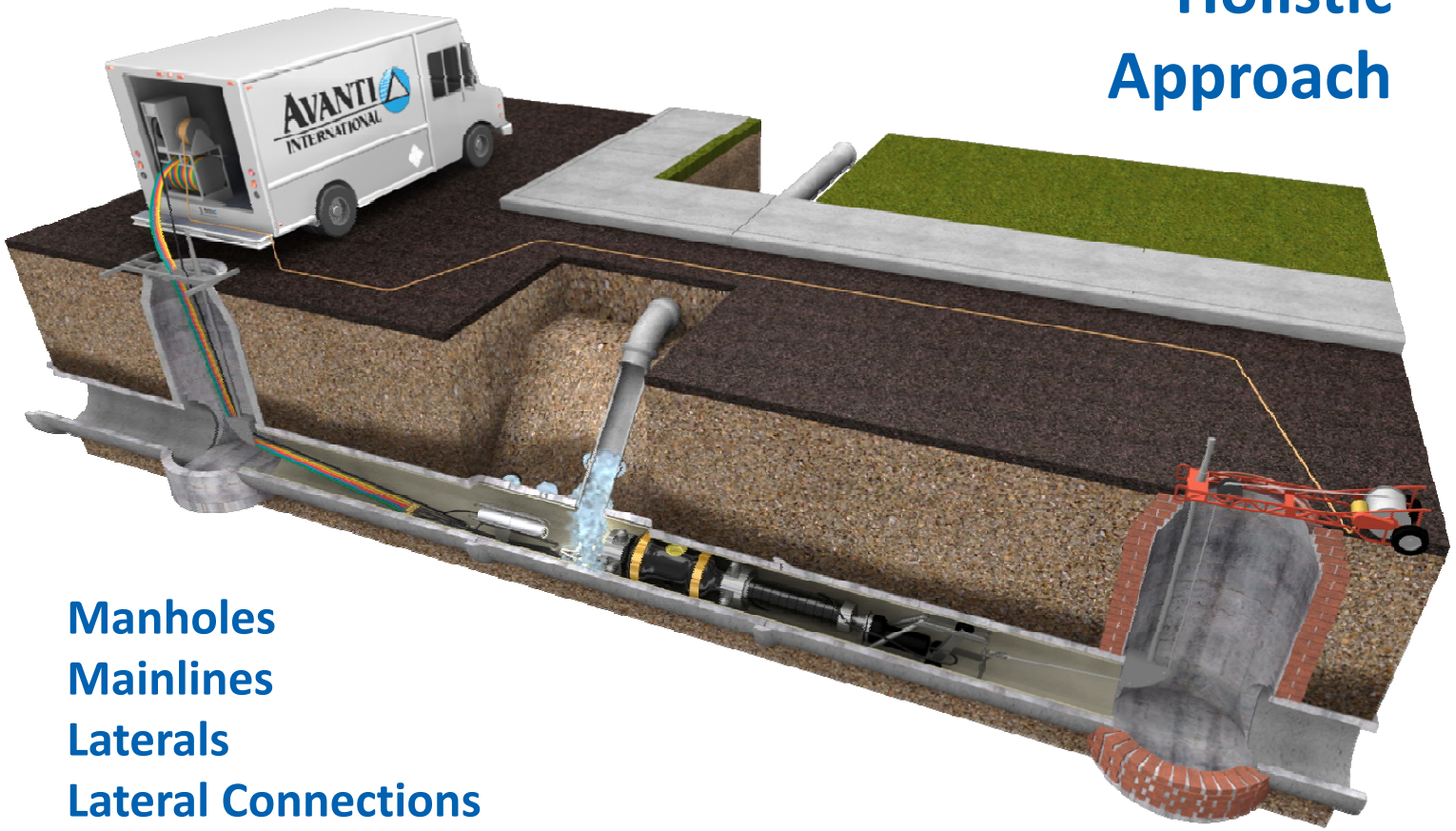
Stage 2: Development of zones of loose ground or voids caused by the loss of ground into the sewer.

Stage 3 Failure of the sewer pipe.



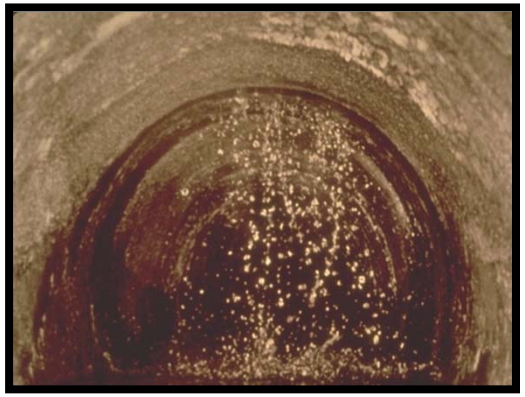
Systematically Seal System

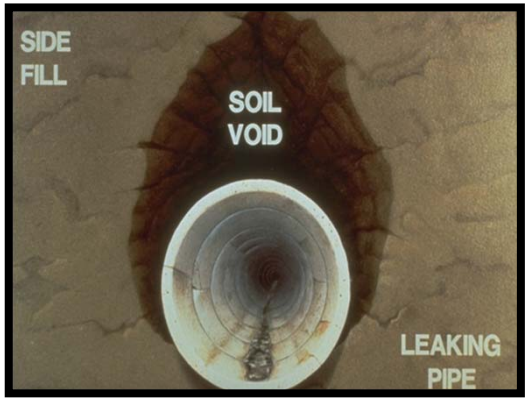
Holistic Approach



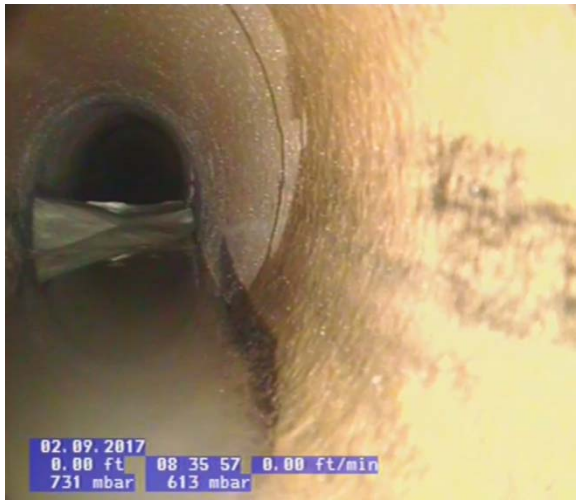
Manholes
Mainlines
Laterals
Lateral Connections

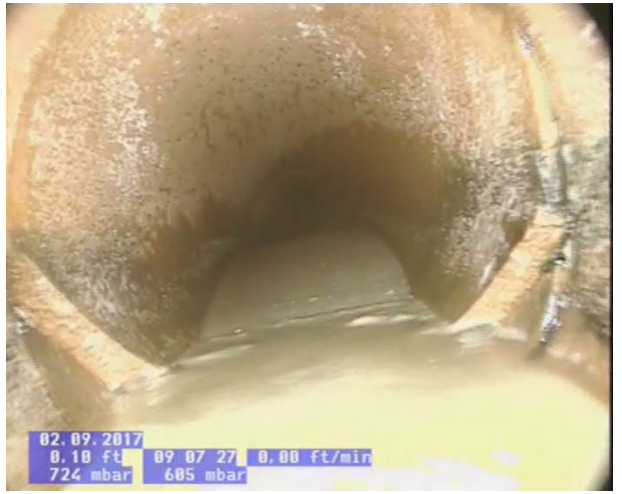
Demo & Discussion
Soil Fines infiltration





Find & Fix quickly



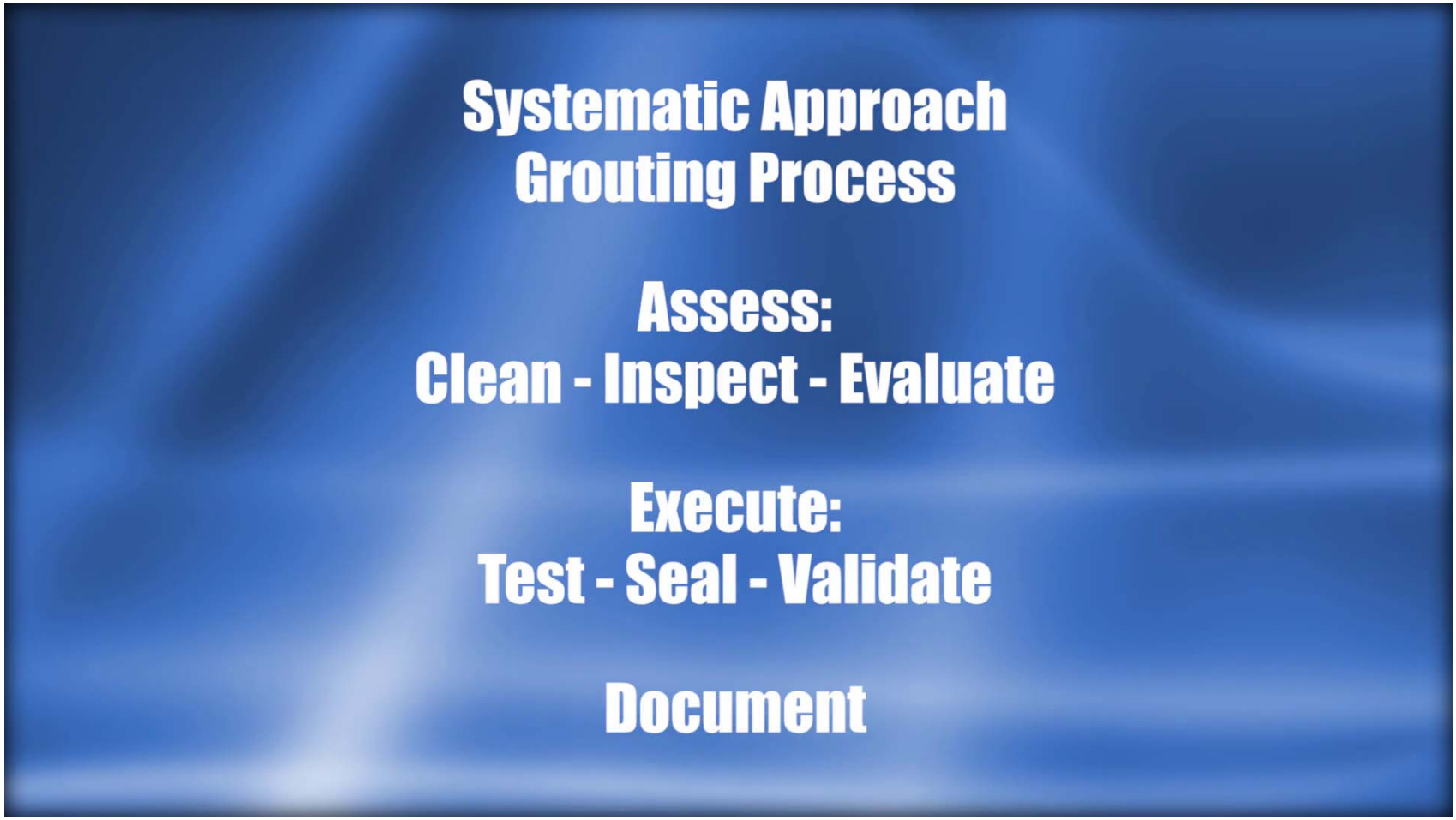


Left non-addressed, infiltration issues can lead to tragic failures





Test Seal Validate



Test, Seal & Validate

What to expect in Module 3:

- Preventing future infiltration by binding grout with pipe bedding soil

- Systematic Process-repetitive series of operations that achieves a predictable outcome

- Stages of Grouting Process: Assess, Execute & Document


Test, Seal, & Validate

Test, Seal, Validate
Module 3

Take away module 3

- Use a Systematic approach.
- Clean and Evaluate the Collection System.
- Test every mainline joint and lateral in the sewer line.
- Seal the joints/laterals that fail the air test.
- Retest the work performed.
- Document all the work performed.

How Acrylamide Grouting Works

What to expect in Module 4:

- Components and Characteristics of Acrylamide Chemical Grout
- Controllable set times – seconds to hours
- Lifespan determined by U.S. DOE


How Acrylamide Grouting Works

How acrylamide works
Module 4


250
200
150
100

What is Injection grout?

Liquid resin that turn into an impermeable solid in a predictable time frame used to:

- Stop leaks in above grade structures
- Stop infiltration into below grade structures
- Stabilize soils
- Control groundwater
- Seal annular space between host pipe & liner

No such thing as WonderGrout

Dozens of formulations

- Each are engineered to perform different tasks
- Additives change outcomes
- Technology you control
- Technology engineers can specify
- What you know—matters

Primary Grout Families

ACRYLIC GROUTS

- **Acrylamide**
- **NMA / Acrylic**
- **Acrylate**

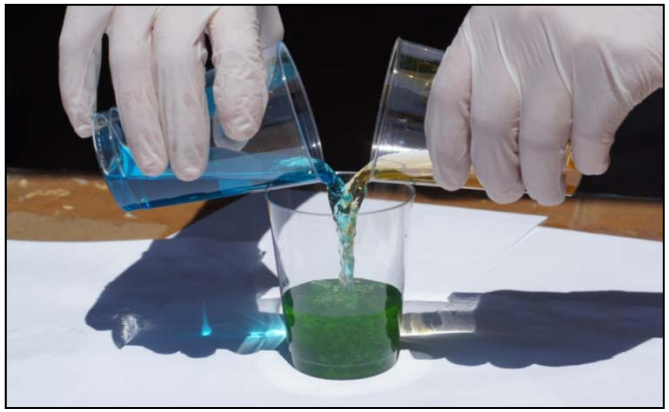
POLYURETHANE GROUTS

- **Gel / Foam**
- **Flexible / Rigid**

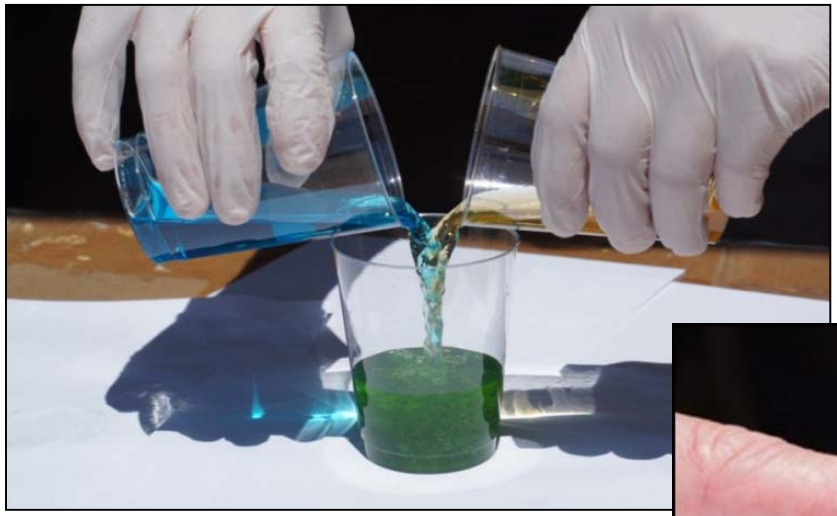
CEMENTITIOUS GROUTS

Why Acrylics for Mainlines / Laterals?

- Thinnest products on the market
- No suspended particles
- Field-adjustable cure times
- Field-adjustable gel strengths
- Soap and water clean up
- Not activated by moisture
- No need for solvents
- Successful track record



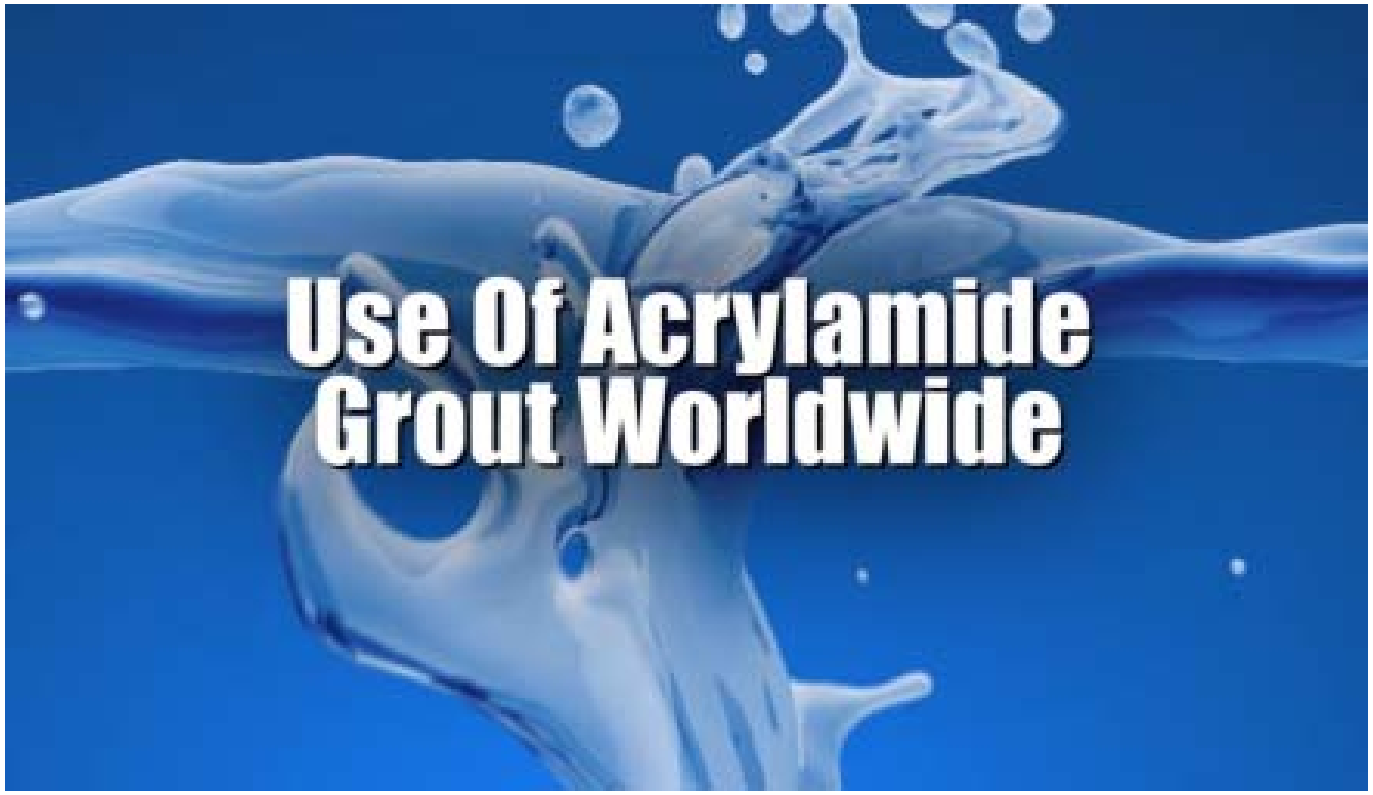
Demo & Discussion
Sample Cup Test



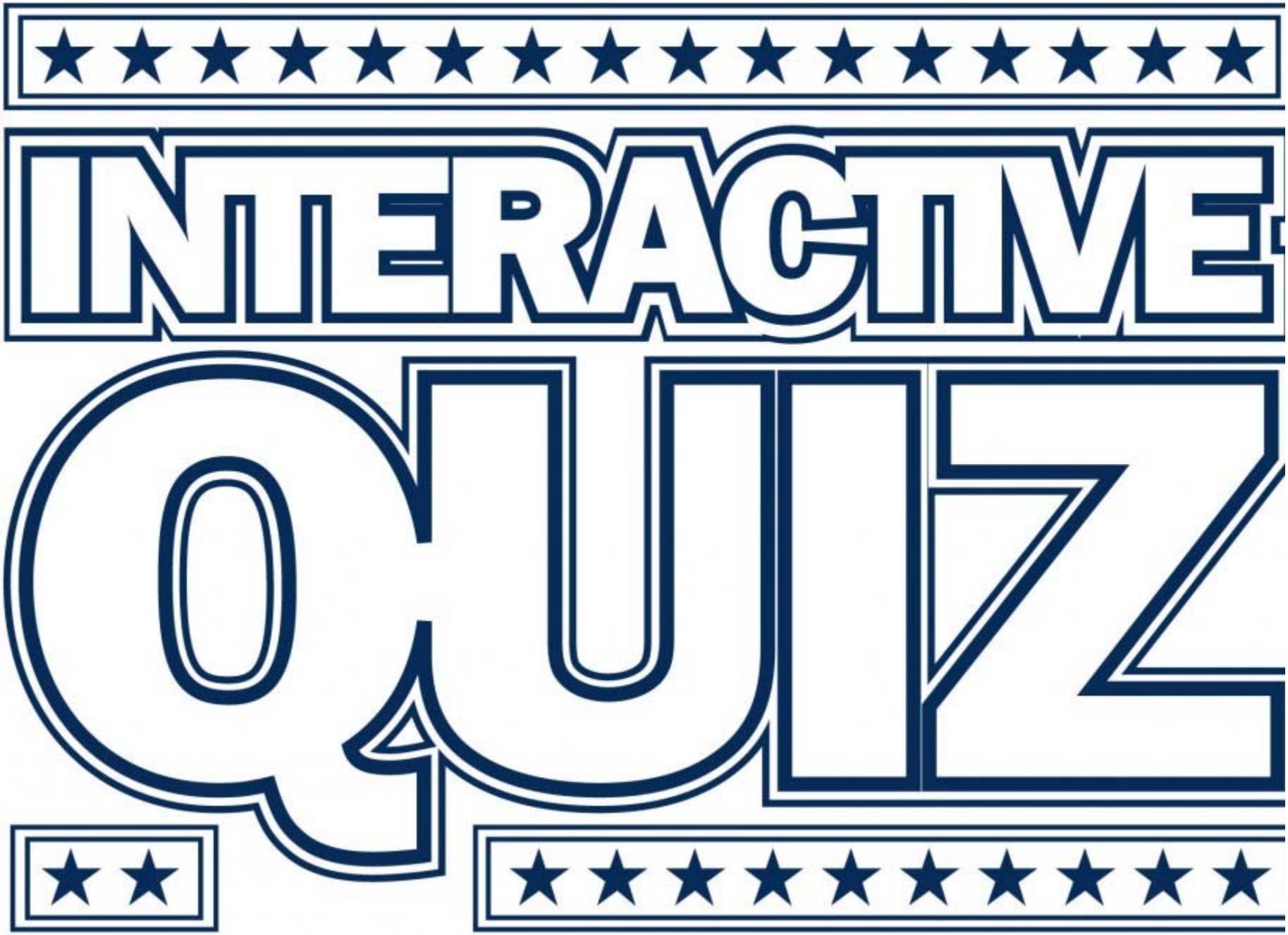
Use of Acrylamide Grout Worldwide

What to expect in Module 5:

- Twenty-year testing and monitoring of Acrylamide grout performed by the U.S. Department of Energy
- Acrylamide grout use across multiple industries and applications
- Largest chemical grouting project in the United States


Use Of Acrylamide
Grout Worldwide

Use of Acrylamide Worldwide
Module 5


INTERACTIVE
QUIZ

Interactive Quiz—Group Answers

1. What is the primary component of acrylamide grout ?

2. In the early 1900's, vitrified clay pipe (VCP) was predominantly laid in what lengths?

3. What is the longevity of AV-100 acrylamide grout as determined by US DoE?

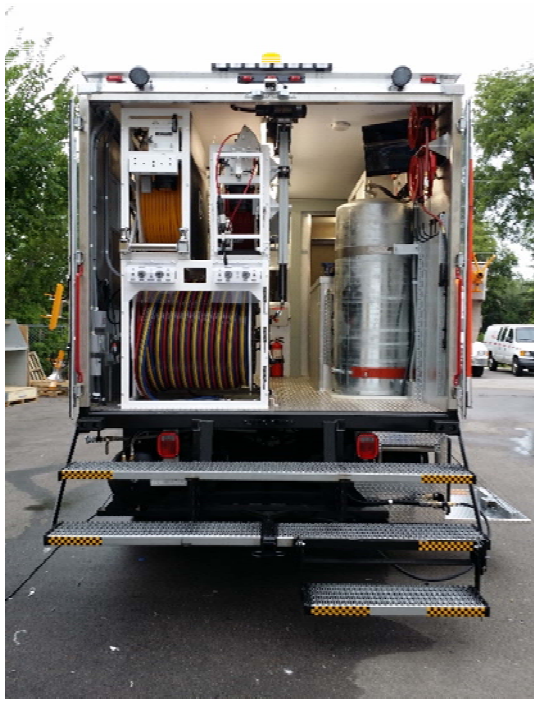
Time for a Break!

Let's take 10 minutes

ARIES
INDUSTRIES, INC.

Grout Truck

Chassis Selection and Options



Grout Truck Overview

What to expect in Module 6:

- Grout truck system and equipment walk through
- Grout delivery system – five hoses from one entry point
- Grout mixing, control room and data collection for testing, sealing and validating


Grout Truck Overview

Grout Truck Overview
Module 6

Aries
Grout Test & Seal System

Panel is divided into two sections.

1. Upper section is the Air system. It supplies air for packer inflation and testing of the joint integrity. It also has the readouts of the transducer pressures so that we can measure the actual air or chemical pressures in the void testing chamber.
2. Lower section Grout controls are for the electrical pumps and has gauges for the pump pressures and gallons pumped indicator.

Air Regulation

1 Air supply pressure
2 System pressure
3 End Element pressure
4 Void Control pressure
5 Sleeve/Plug pressure
6 End Hose
7 Test Hose
8 Sleeve Plug
9 Pump Supply
10 Void Pressure Read Out

Air Activation

12 Rapid Inflate Timer
13 Rapid Inflate
14 Standard Inflate
15 Test Inflate
16 Test Hold
17 Sleeve Inflate
18 Deflate/Stop
19 Timer

Grout Control

21 Gallons Pumped
22 Zero Button
23 Blue Pump Chemical Pressure
24 Red Pump Chemical Pressure
25 Pump Speed Control
26 Pump On/Off
27 Test port for 12VDC/20VDC
28 Water Tank Indicator lamps
29 AC power
30 DC power

Lateral Panel control

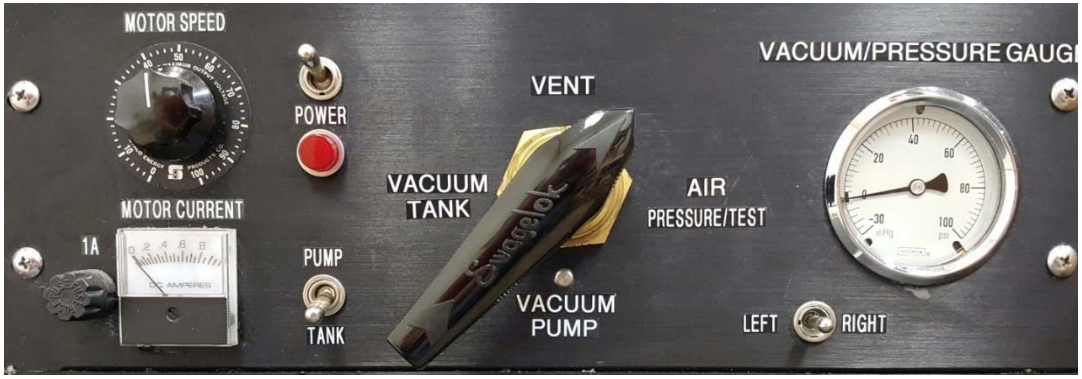
1 Four way valve for inflation and vacuum of the lateral plug.

2 Vacuum/Pressure gauge for lateral plug information.

3 Motor Speed control for the packer rotation.

4 Left/Right switch for packer rotation.

5 Pump/Tank solenoid for vacuum control.



Process of Sealing Mainlines

What to expect in Module 7:

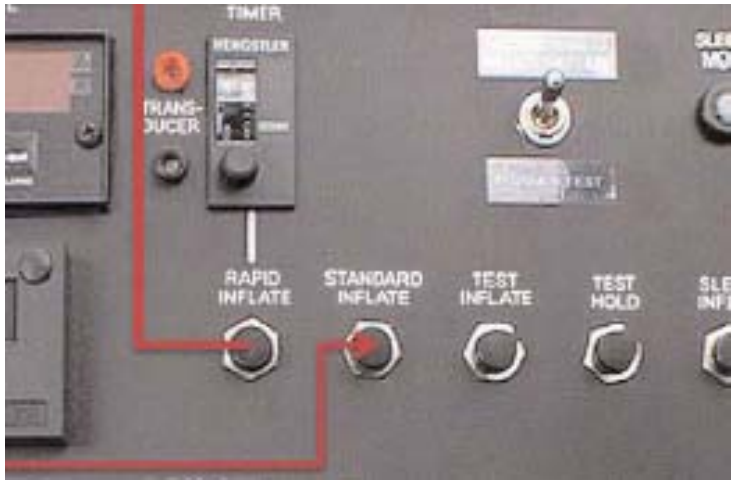
- How mainline packers operate
- If a joint/crack leaks air, it will leak water
- Understanding key components of sealing mainline joints

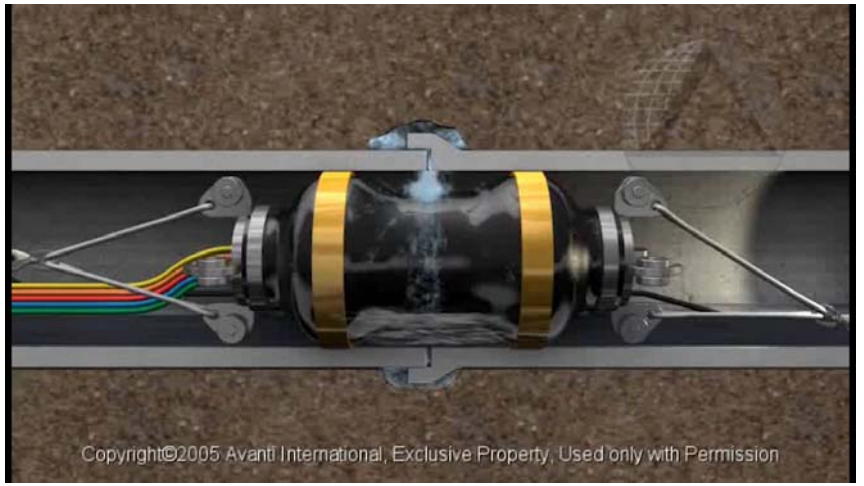

Process Of Sealing Mainlines

Process of Sealing Mainline
Video 7

Inflation of the End Elements

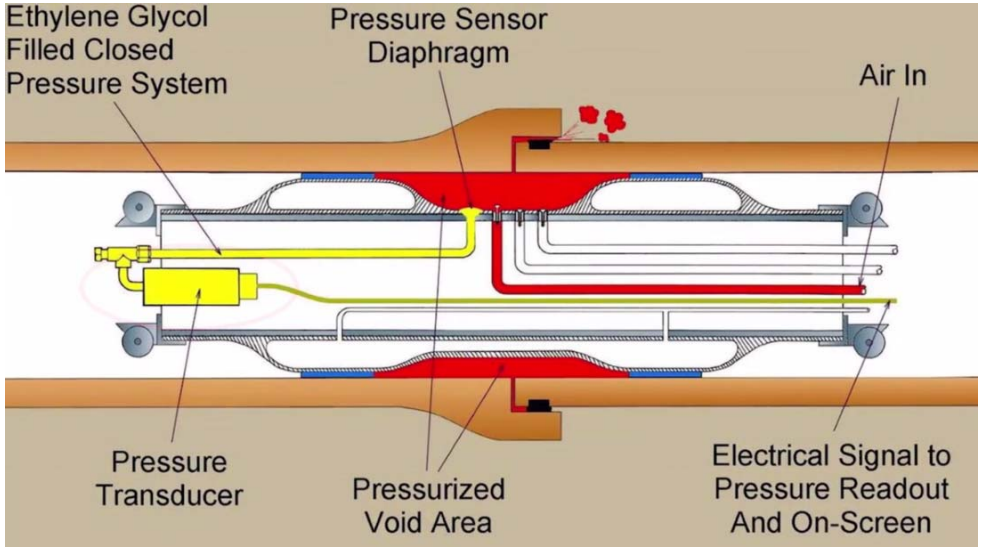
Pressing the Rapid inflate or Standard inflate will cause the ends of the packer to inflate and seal against the pipe wall.





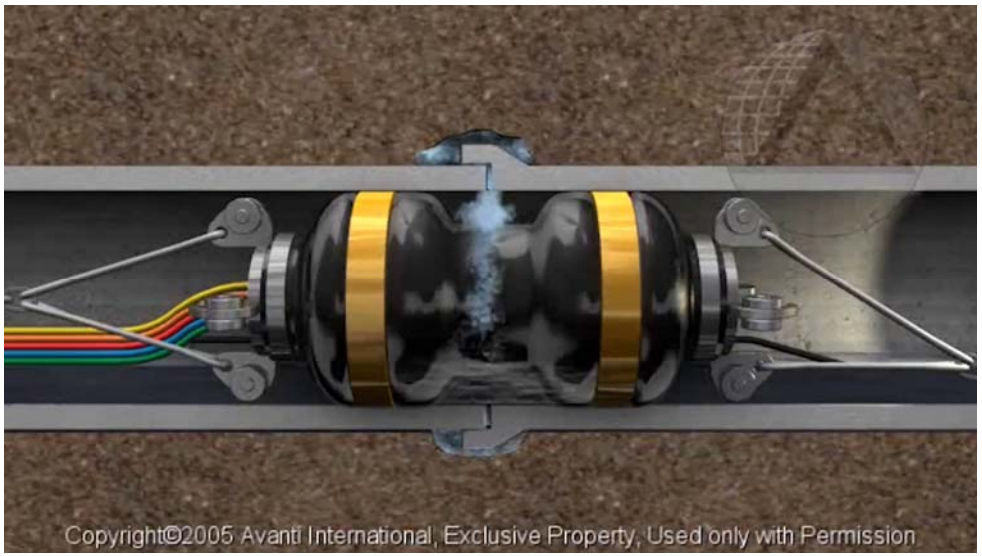
Air Test Procedure

Once the ends elements are inflated an air test of the joint is conducted. The operator will press the Air Test button and Air is sent down the hose reel to the Air Check valve in the packer. As the air pressure increases to specification the operator will then press the Test hold button cutting off the air supply. Pressure Transducer sends the signal back to the Air Test Gauge where the operator confirms pass/fail.



Pumping Grout

Start pumping grout at a rate of **four gallons** per minute. Vary the pumping rate by adjusting the speed control to maintain an even pressure from the void pressure gauge until the grout starts to gel. When gelling, the pressure will increase rapidly to between 10 and 20 psi with in a 5 second period. The pump must then be stopped. This process is called grouting to refusal. Allow 40 to 60 seconds to cure gel.

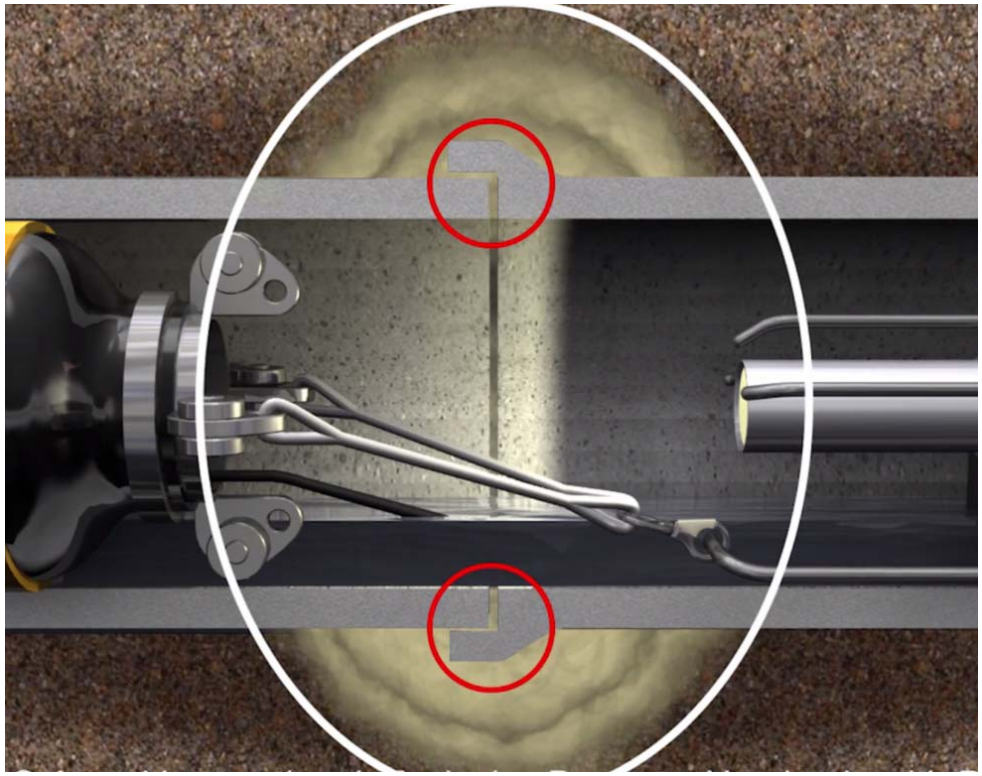


Verification of process

After curing, relax packer ends by pushing the red Stop button. This releases end element air and the packer separates from the sewer line wall.

Re-inflate end elements and re-test with air or grout, pressurizing the grouted area to test pressure level and holding for a fixed period of time.

Move through the sewer line and test every joint. Grout as needed.



Main Line Grouting
Take away.

1; Main line is Cleaned.

2; Packer is pulled into position on the Joint.

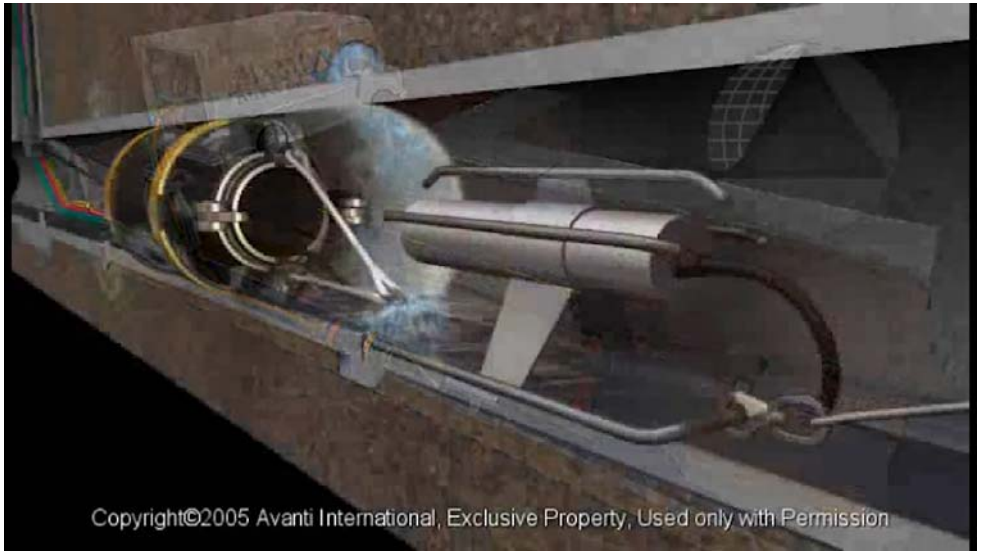
3; End elements are inflated.

4; Air test performed on a joint not visibly leaking.

5; Pump Grout to the point of refusal.

6; Retest the work performed.

7; Deflate End elements.



Mainline Packer Details

What to expect in Module 8:

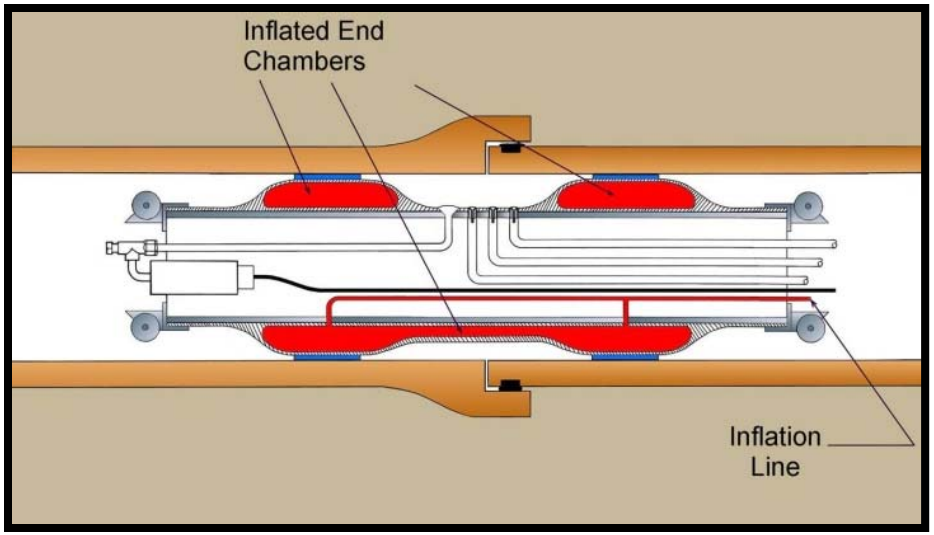
- Understanding mainline packer components
- How pressure is monitored by operator
- The importance of packer-to-pipe void information

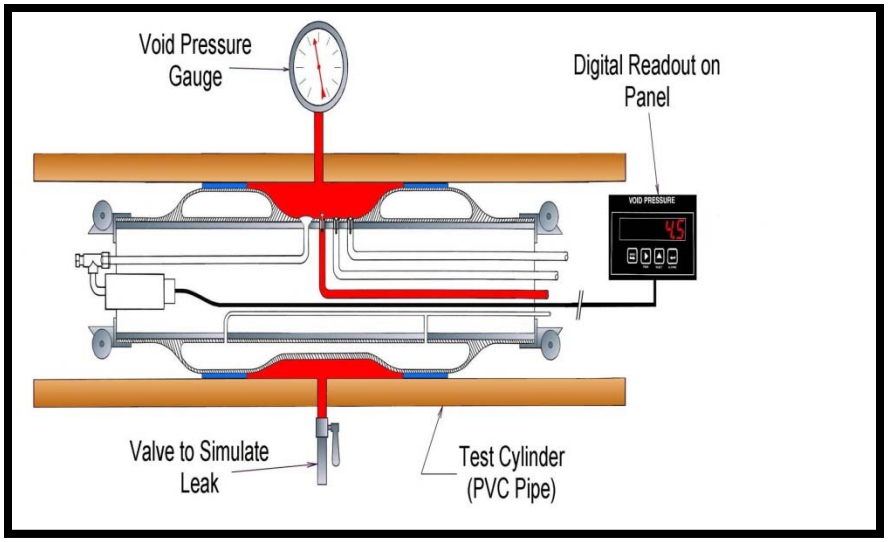

Mainline Packer Details

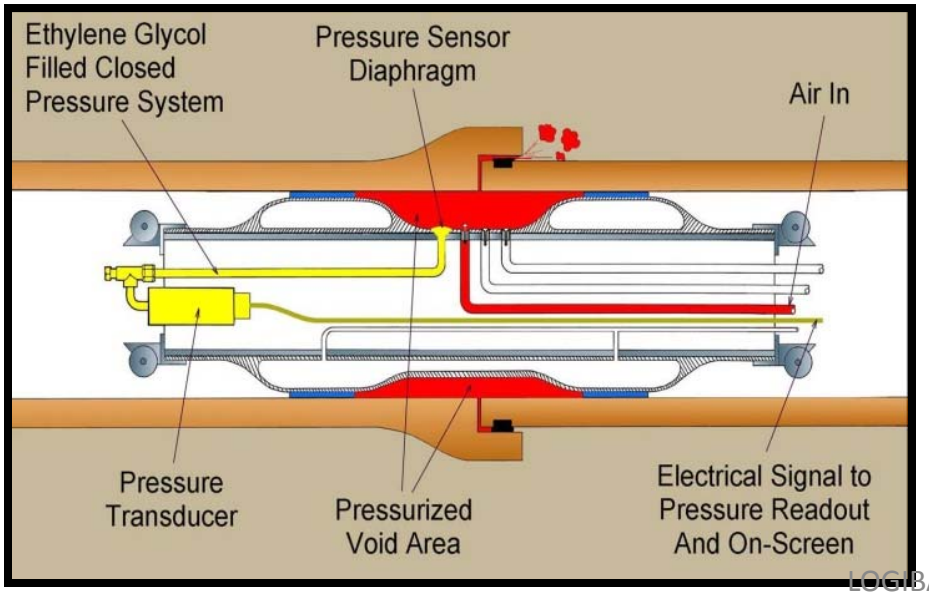
Main line packer détails module 8

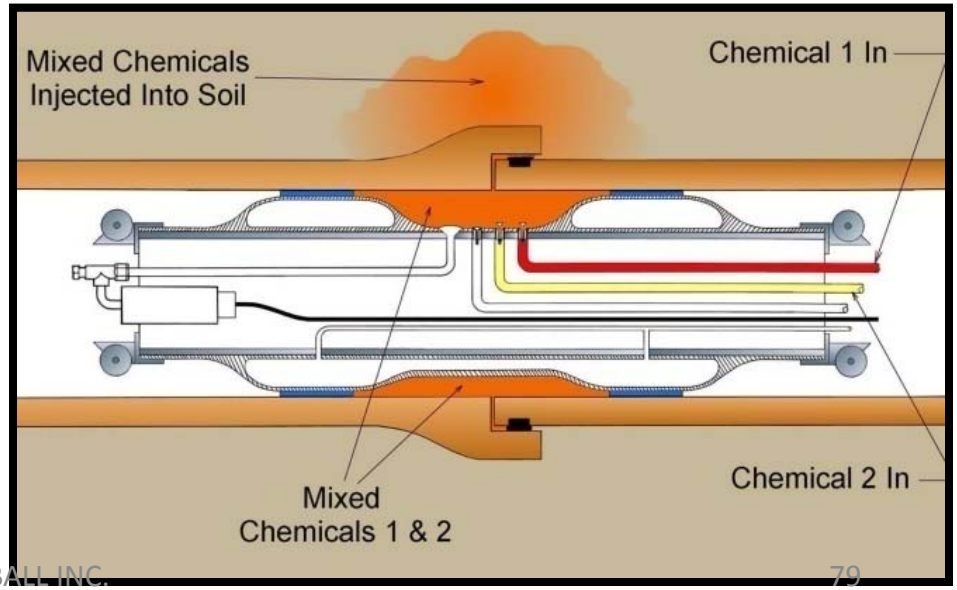
2001JS Series are single size packers 6``-21``

LOGIBALL VOID PRESSURE (TEST& GROUT) MONITORING SYSTEM



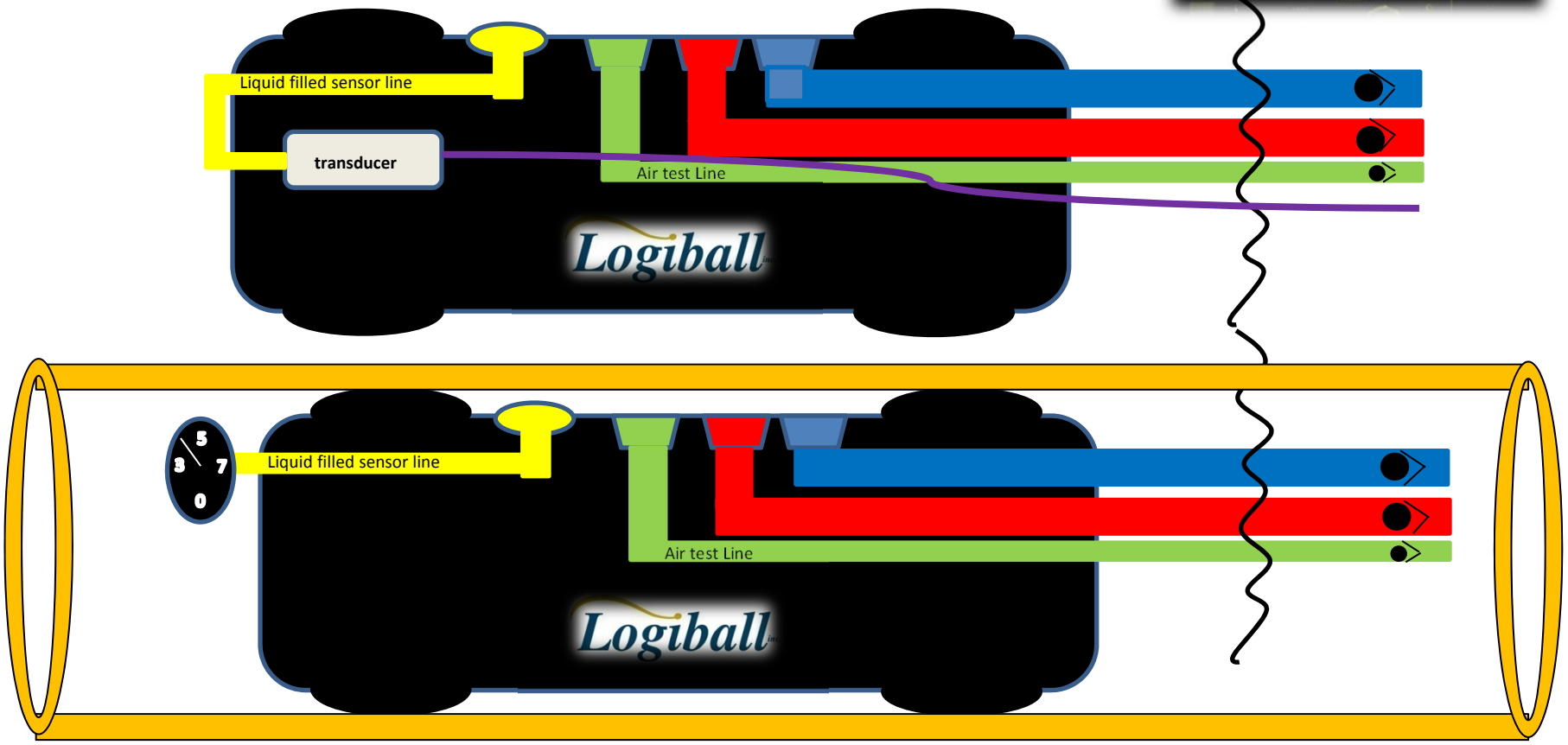




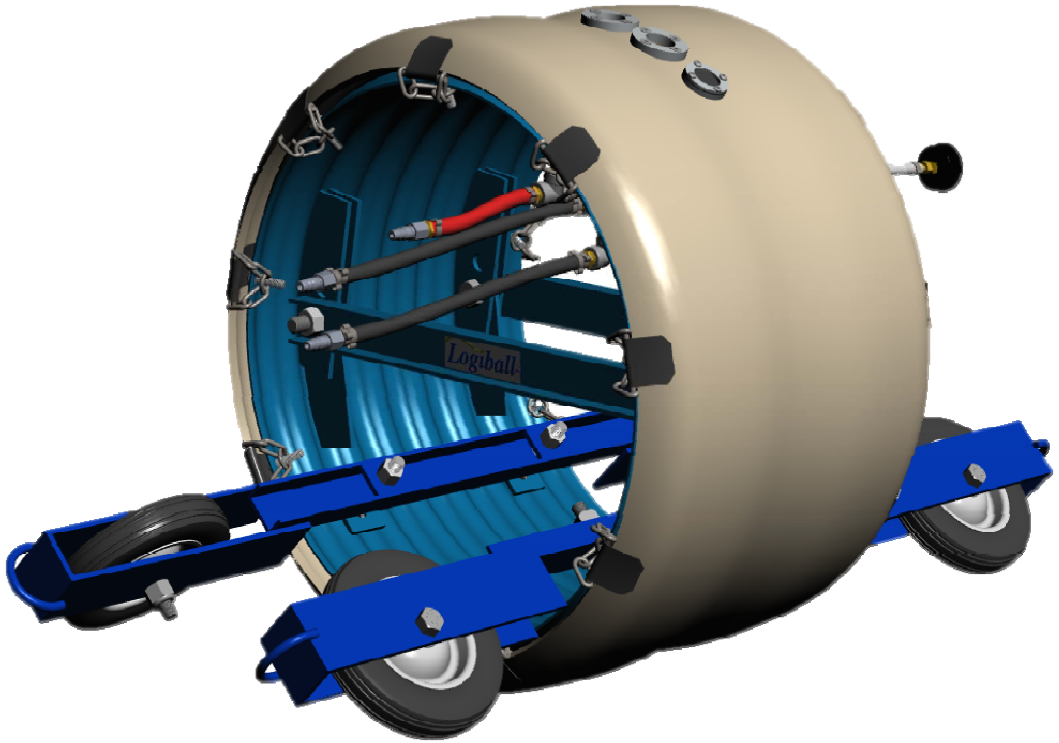


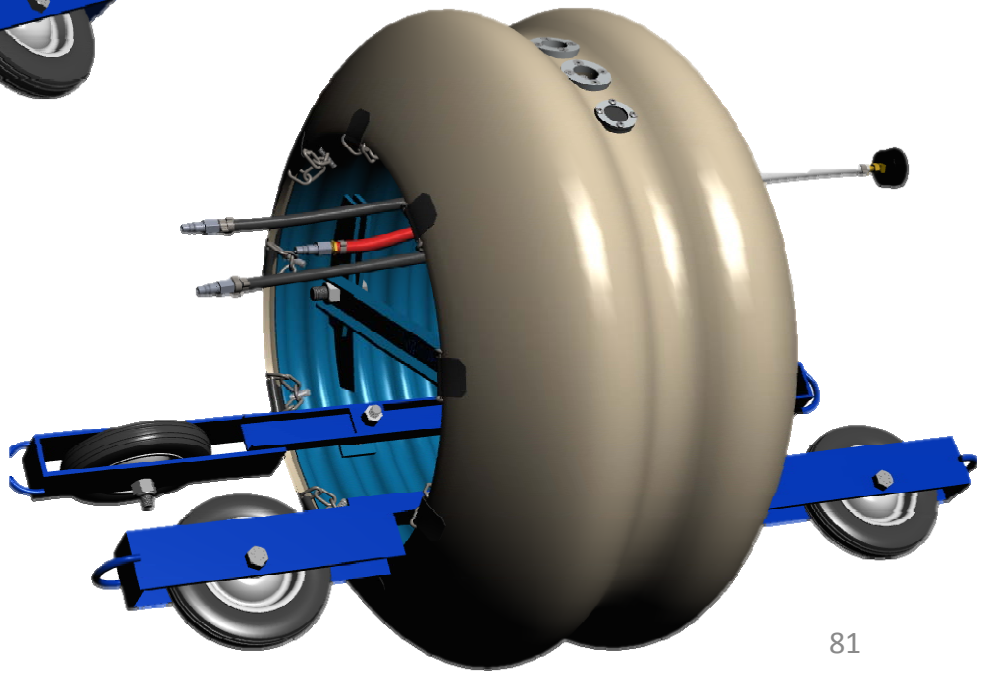
Mainline Packer Void Pressure Sensor System

Logiball packers are designed in such a way as to record pressures (grouting or testing) of the void.



Logiball Collapsible Mainline Test & Seal Packers 24``-144``

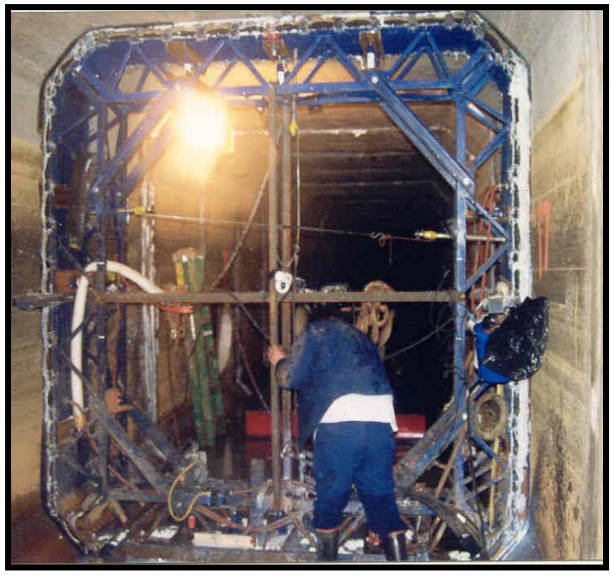




Mainline Sealing Capabilities

Grout Packers for longitudinal cracks

Grout Packers for Box Culverts

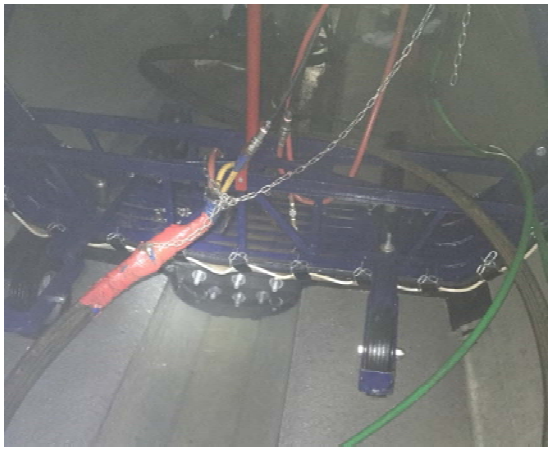


Mainline Test & Seal Packers available for 6” through 144” pipes.

Logiball 54`` Packer residual grout ring

Logiball Custom made Equipment

96`` RCP with 18`` cunette Test & Seal Packer



Intro to process of Sealing Laterals from Mainline
Lateral plexiglass with multiple leaks

Process of Sealing Laterals from Mainline

What to expect in Module 9:

- How lateral packers operate
- Inspection and cleaning are an important part of the process
- Grouting the annulus space between liner and host pipe


Process Of Sealing
Laterals From Mainline

Process of Sealing Laterals from Mainline 9

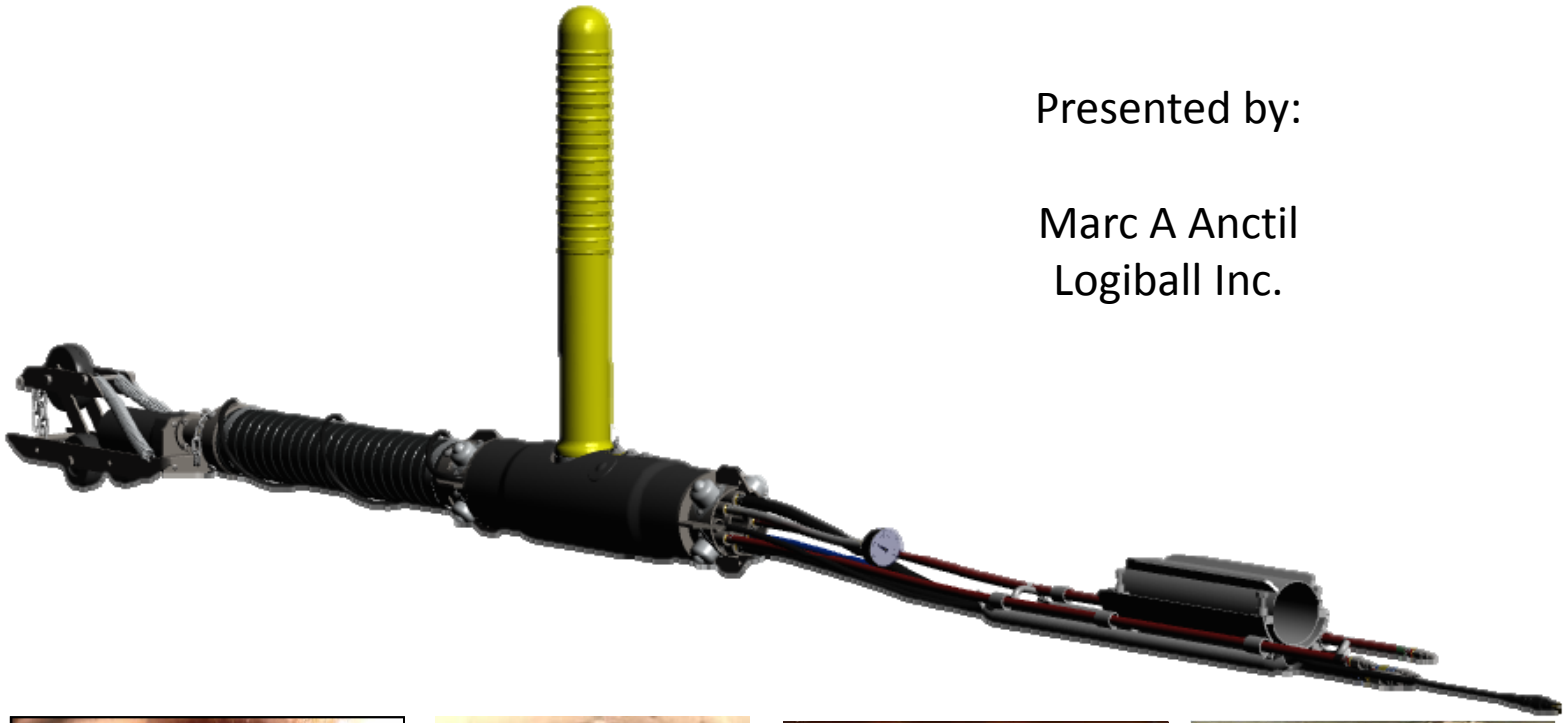
Takeaways (Laterals)

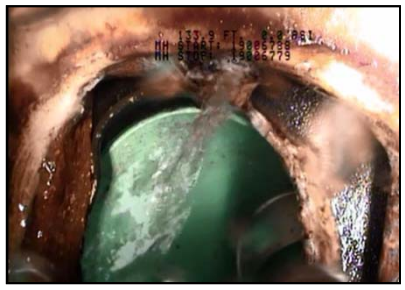
- Laterals must be included in all I/I reduction programs in order to obtain higher infiltration reductions
- Effective sealing distances must be pre-determined to give the best ROI
- Annular spaces in lined pipes can effectively be sealed with injection grouting

Logiball Lateral Test & Seal Packers
Permanent solution to infiltration

Presented by:

Marc A Anctil
Logiball Inc.





Lateral Packer Details

What to expect in Module 10:

- Understanding lateral packer components
- Different lateral packer bladder designs – ranging from 2-30 feet
- What makes lateral grouting cost-effective and versatile

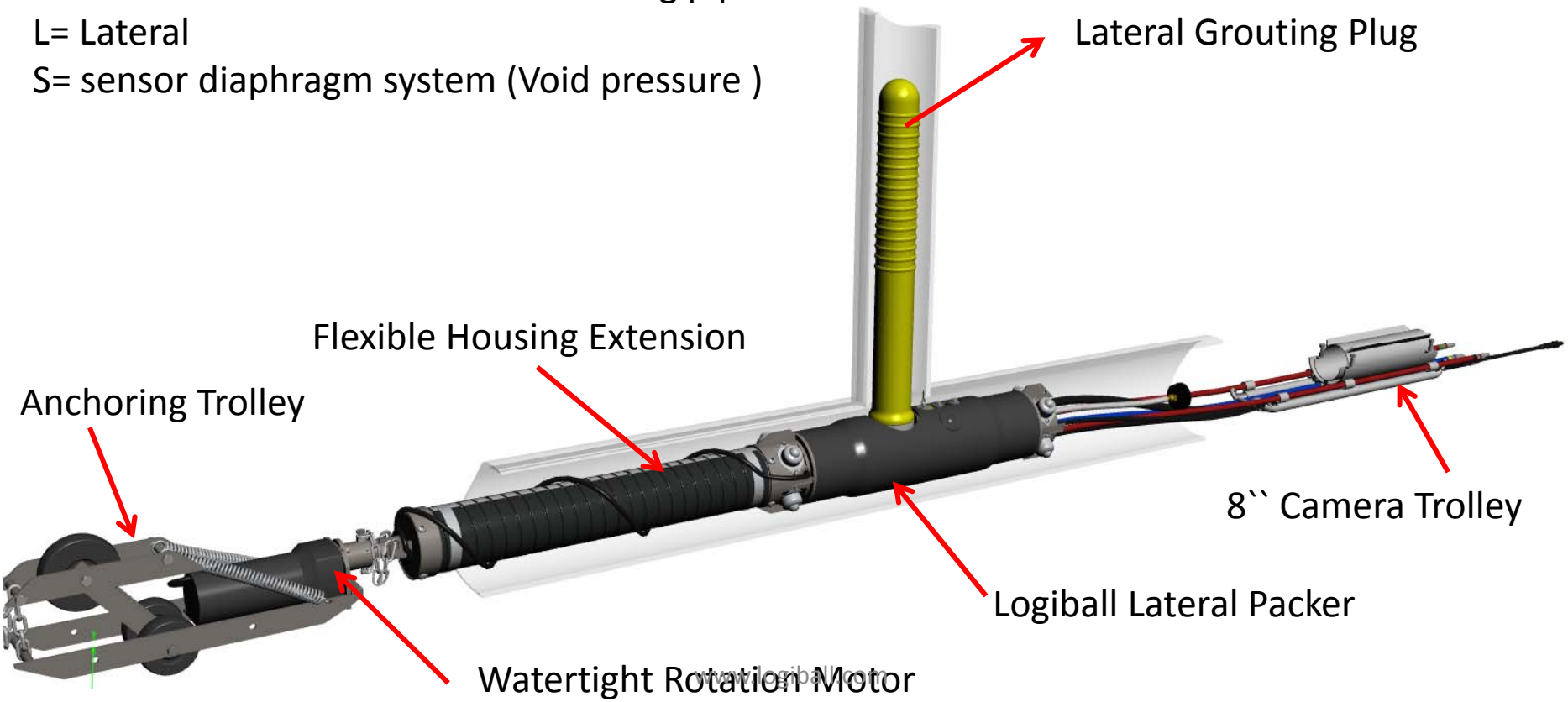

Lateral Packer Details

Lateral Packer Details Video
module 10

Introduction to Lateral Packer Details

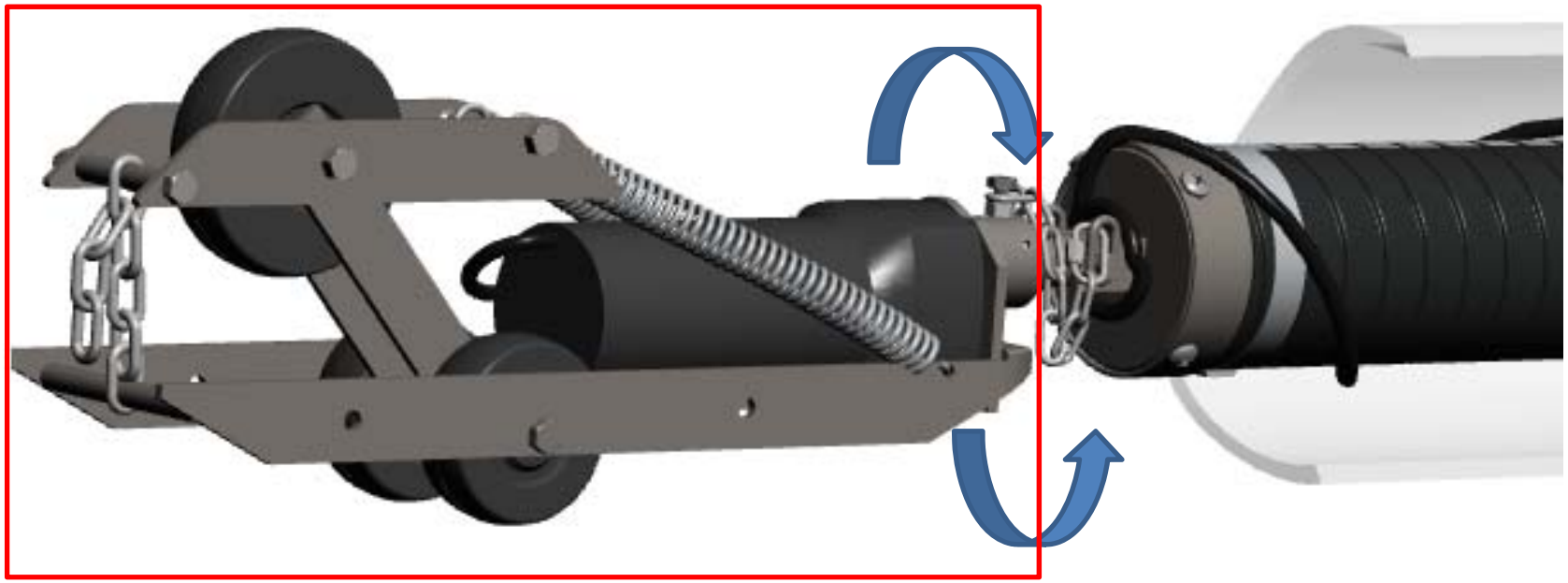
Logiball 5.5-7.5 2001 LS

5.5= Approximate packer rubber o.d.
7.5 = Maximum recommended working pipe diameter
L= Lateral
S= sensor diaphragm system (Void pressure)



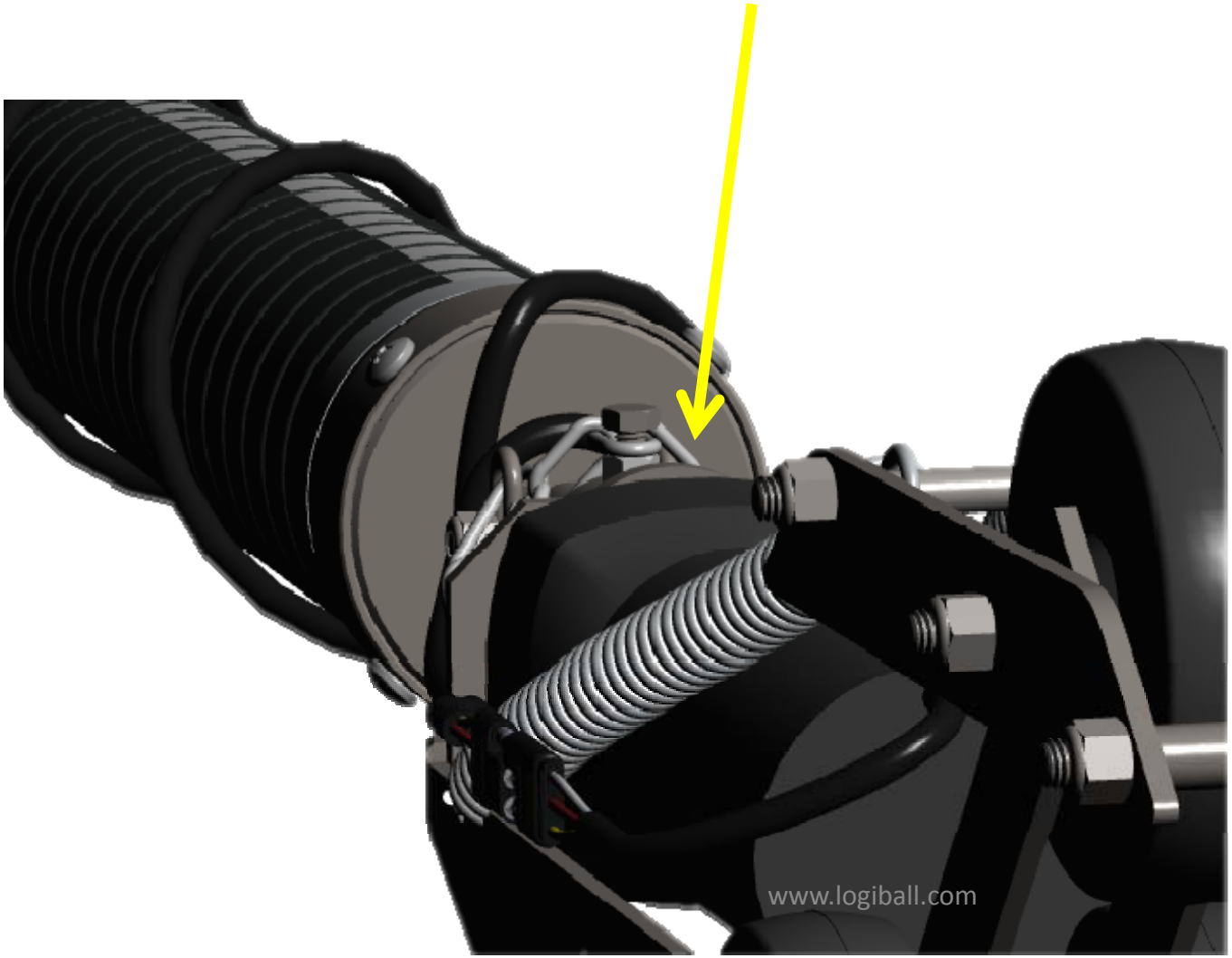
Logiball 2001 LS Lateral Test & Seal Packer

Anchoring Trolley & Rotation motor



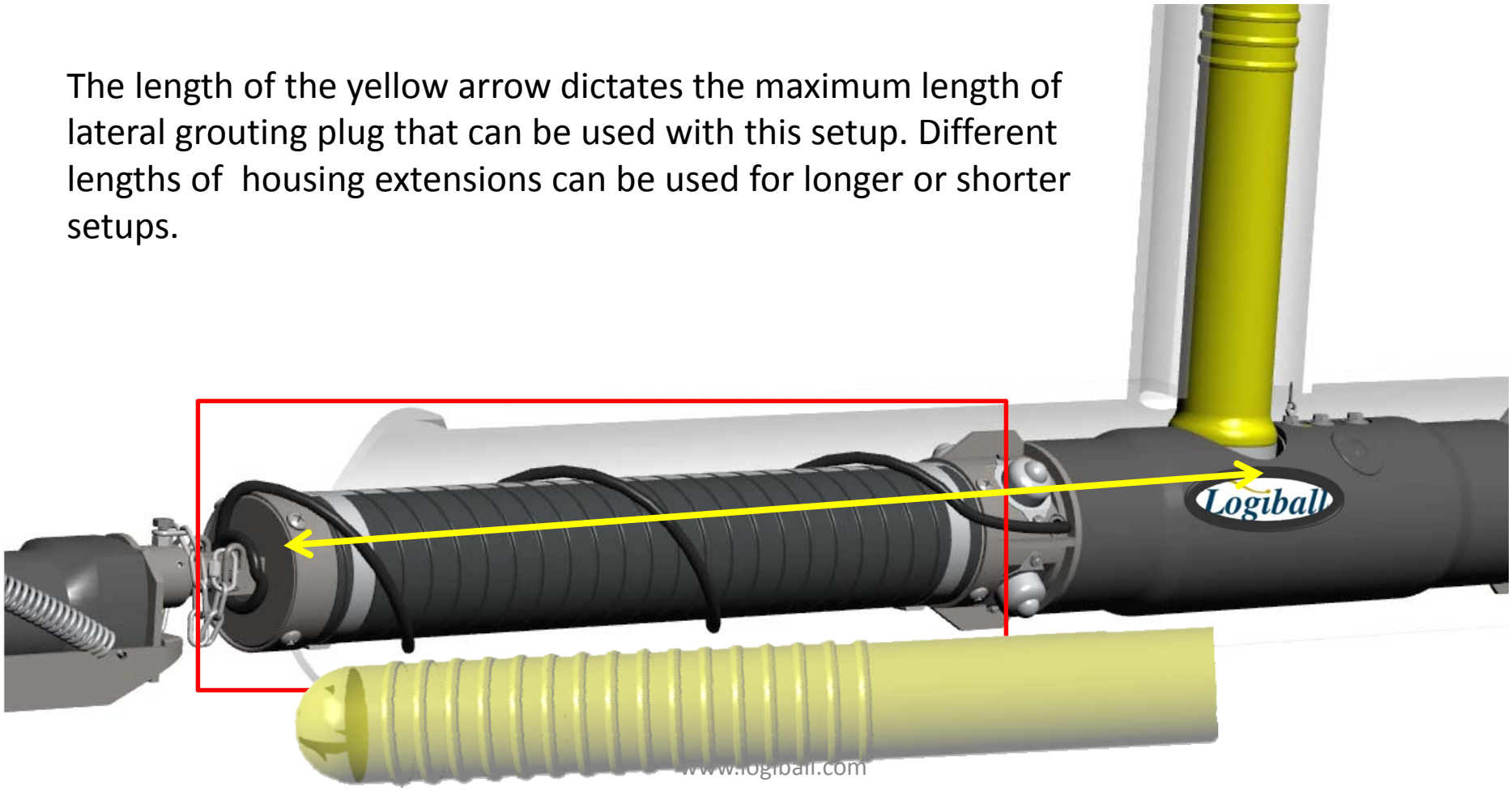
Packer rotation

Untangle chains, chains should allow 1.5 turns cw or ccw.



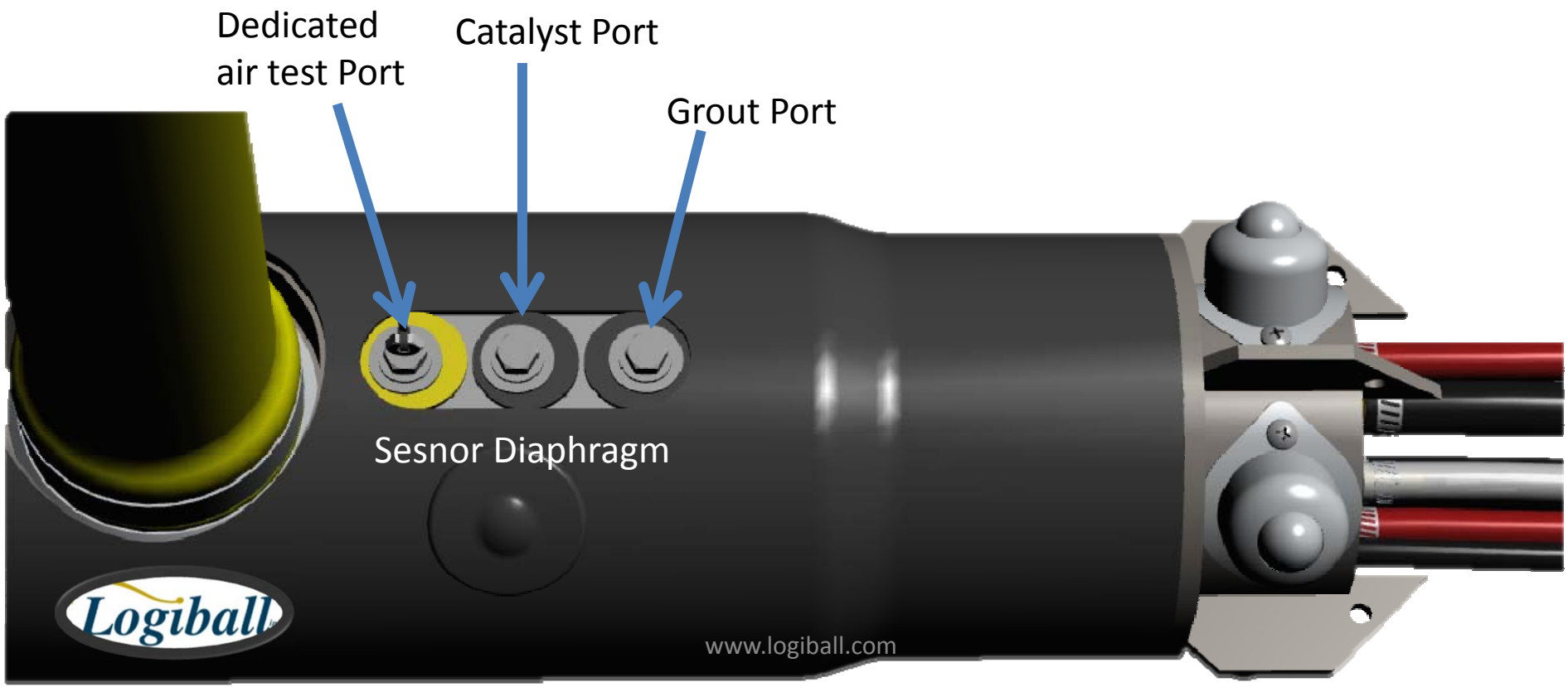
Flexible Housing Extension for Lateral Grouting Plug storage

The length of the yellow arrow dictates the maximum length of lateral grouting plug that can be used with this setup. Different lengths of housing extensions can be used for longer or shorter setups.



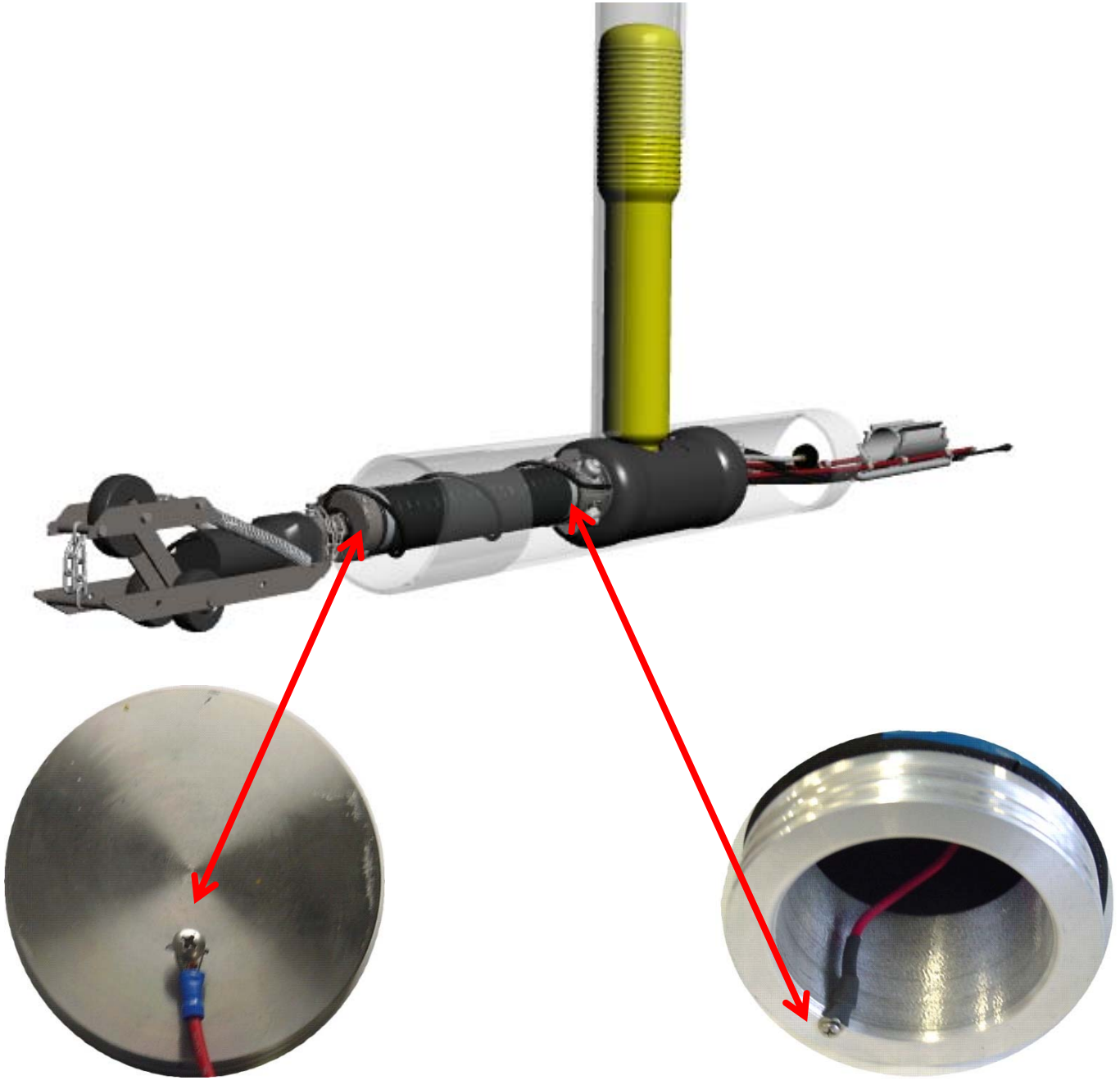
5.5-7.5 2001 LS grout &test ports with sensor diaphragm

Since there are three independant ports on this packer the ``H`` block assembly is not required



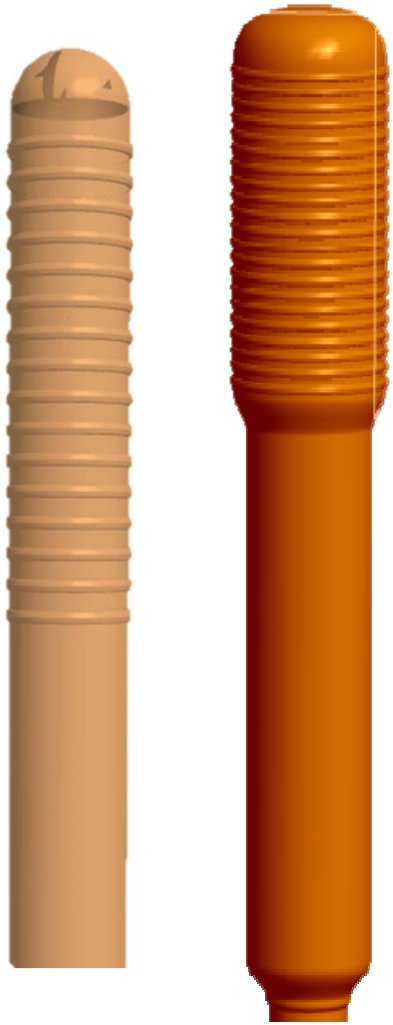
Flexible Housing Extension

Vacuum



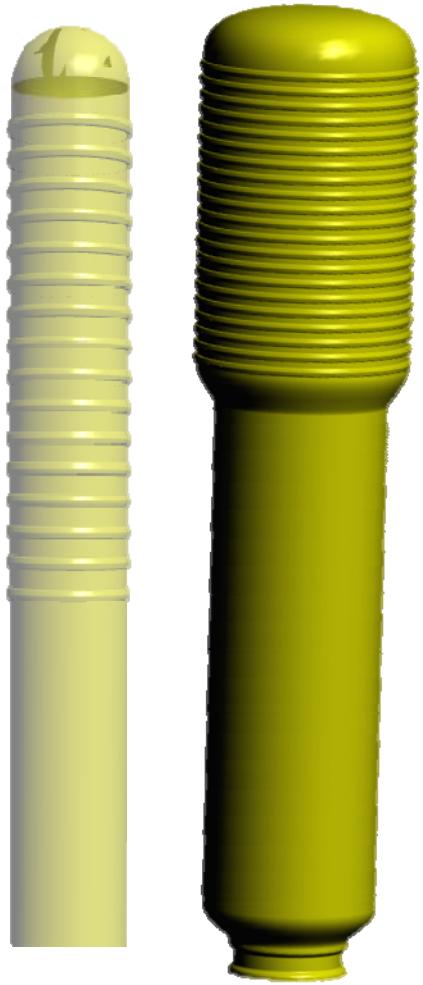
Lateral Grouting Plugs

Orange = 4``



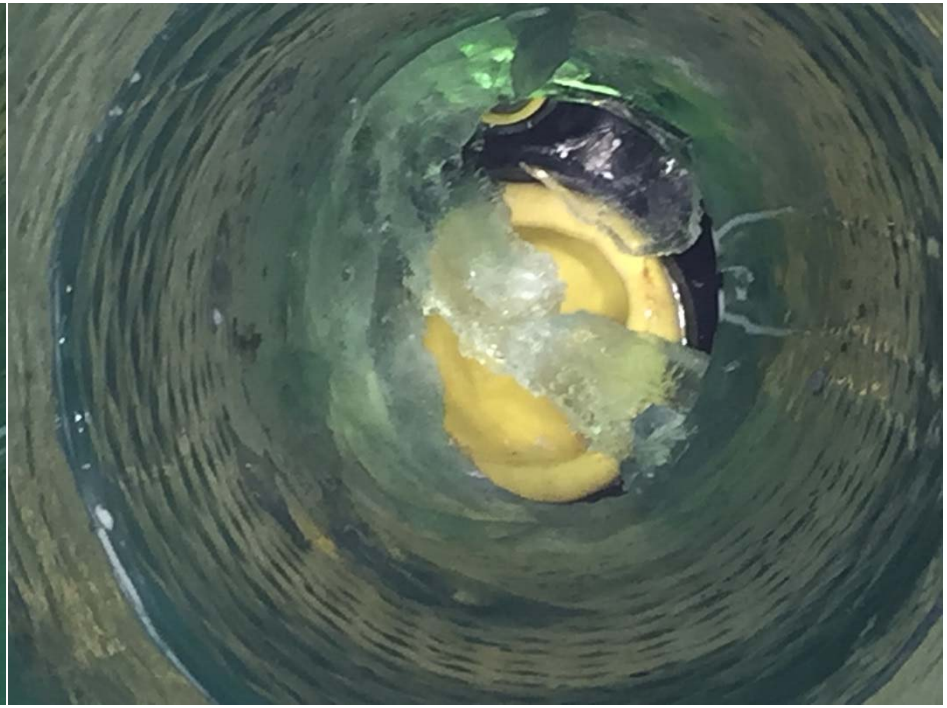
Choosing and using the appropriate diamater of lateral grouting plug will limit the residual grout left in the lateral. Different views as seen on the next slide can provide different perspectives.

Yellow = 6``



Lateral Grouting Plugs

Residual grout ring when using appropriate sized lateral bladder as sean from cleanout view. Thin residual material left on the inside pipe wall will eventaully peel off and go down with the flow.



Void volume between inflated packer and pipe to determine appropriate gel time

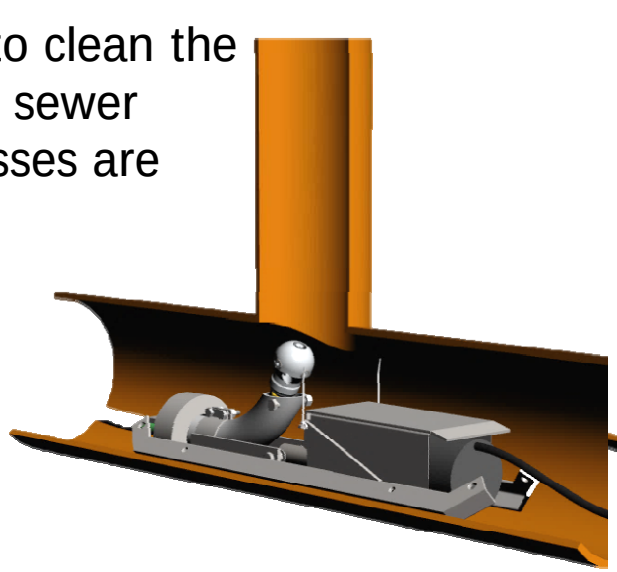
Obtaining a double seal in lined pipes

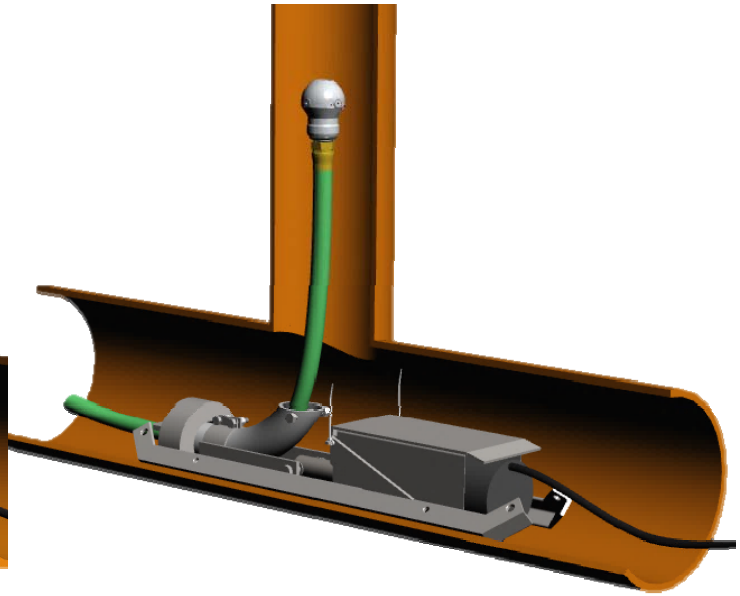
Lateral Tap Connection Grouting Capabilities

Mainline diameters from 6”-30 with effective sealing distances from 8” through 30 feet have been done. Diameter of laterals 4”, 5” or 6”.

Cleaning Laterals from The Main

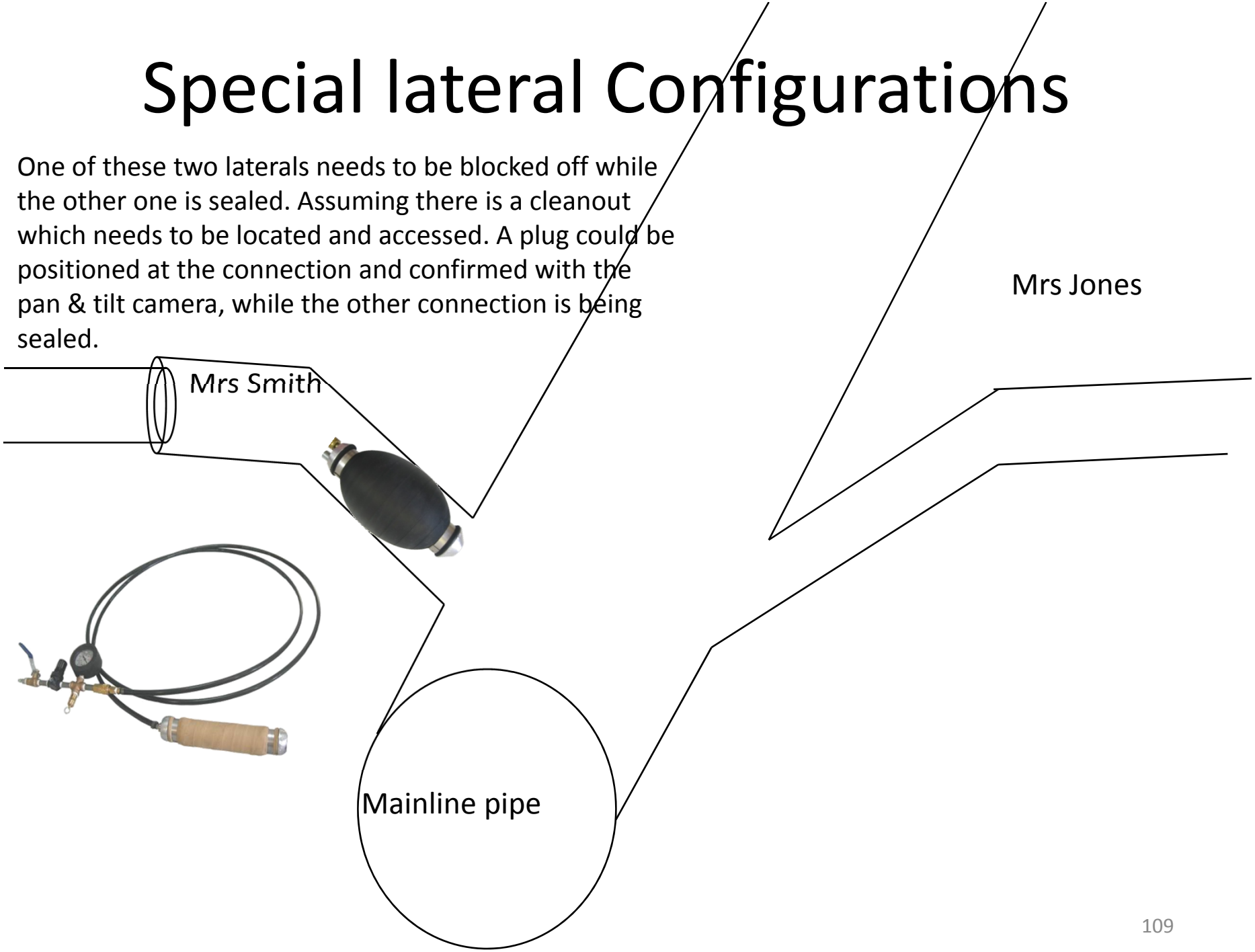
There are effective tools to clean the laterals from the mainline sewer when above ground accesses are inexistant.





Special lateral Configurations

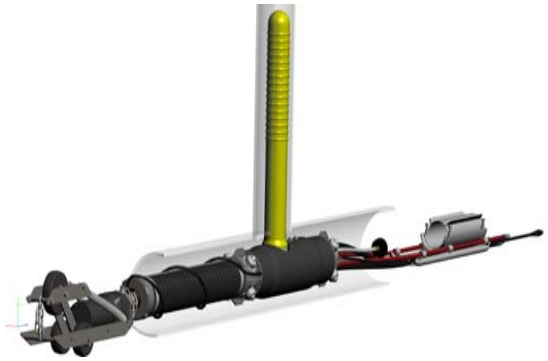
One of these two laterals needs to be blocked off while the other one is sealed. Assuming there is a cleanout which needs to be located and accessed. A plug could be positioned at the connection and confirmed with the pan & tilt camera, while the other connection is being sealed.

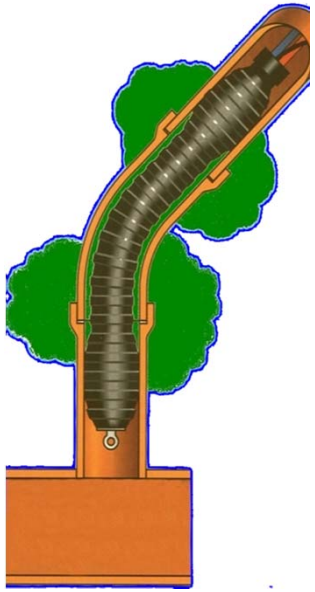


Special lateral Configurations

Mrs Smith

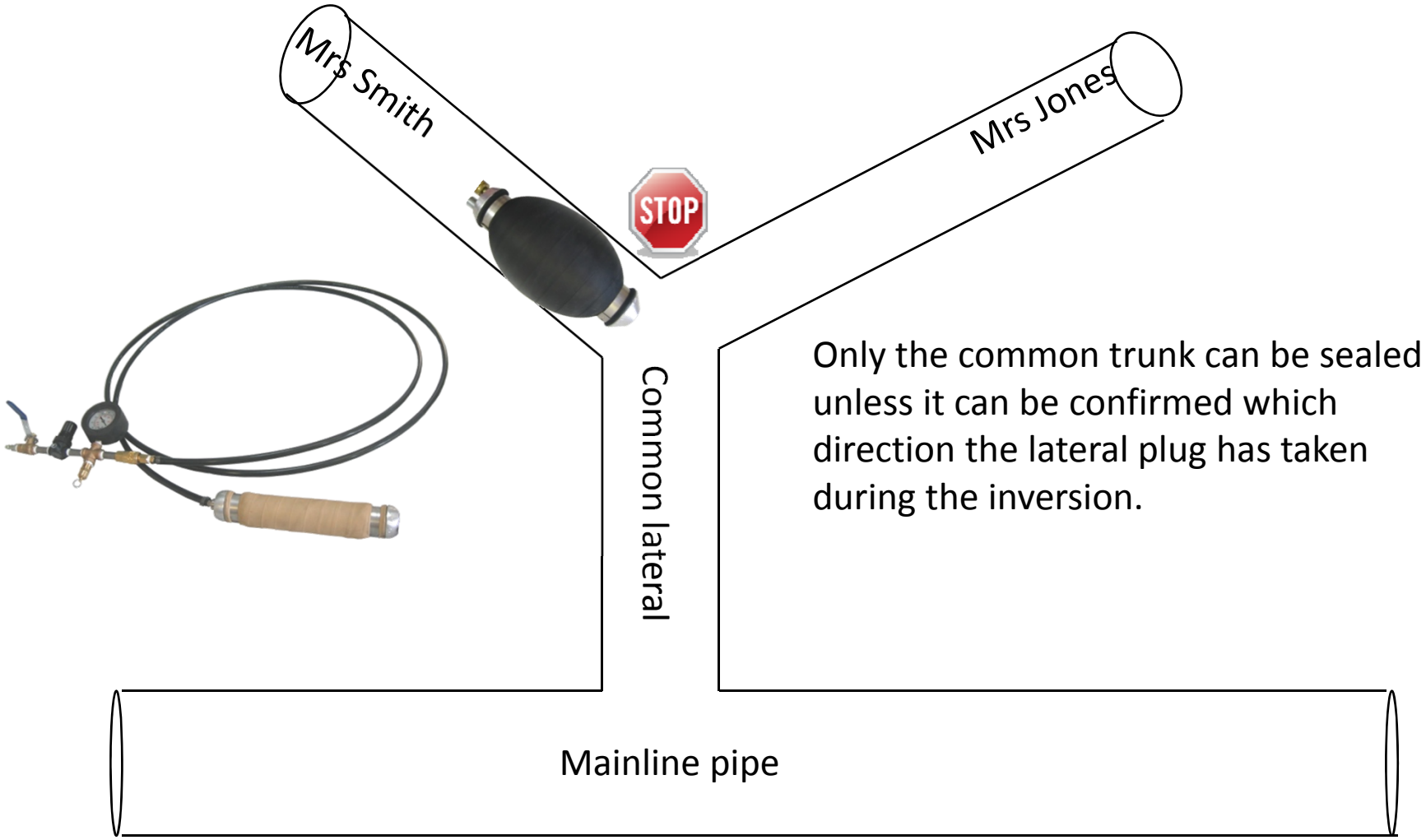
Mrs Jones





Mainline pipe

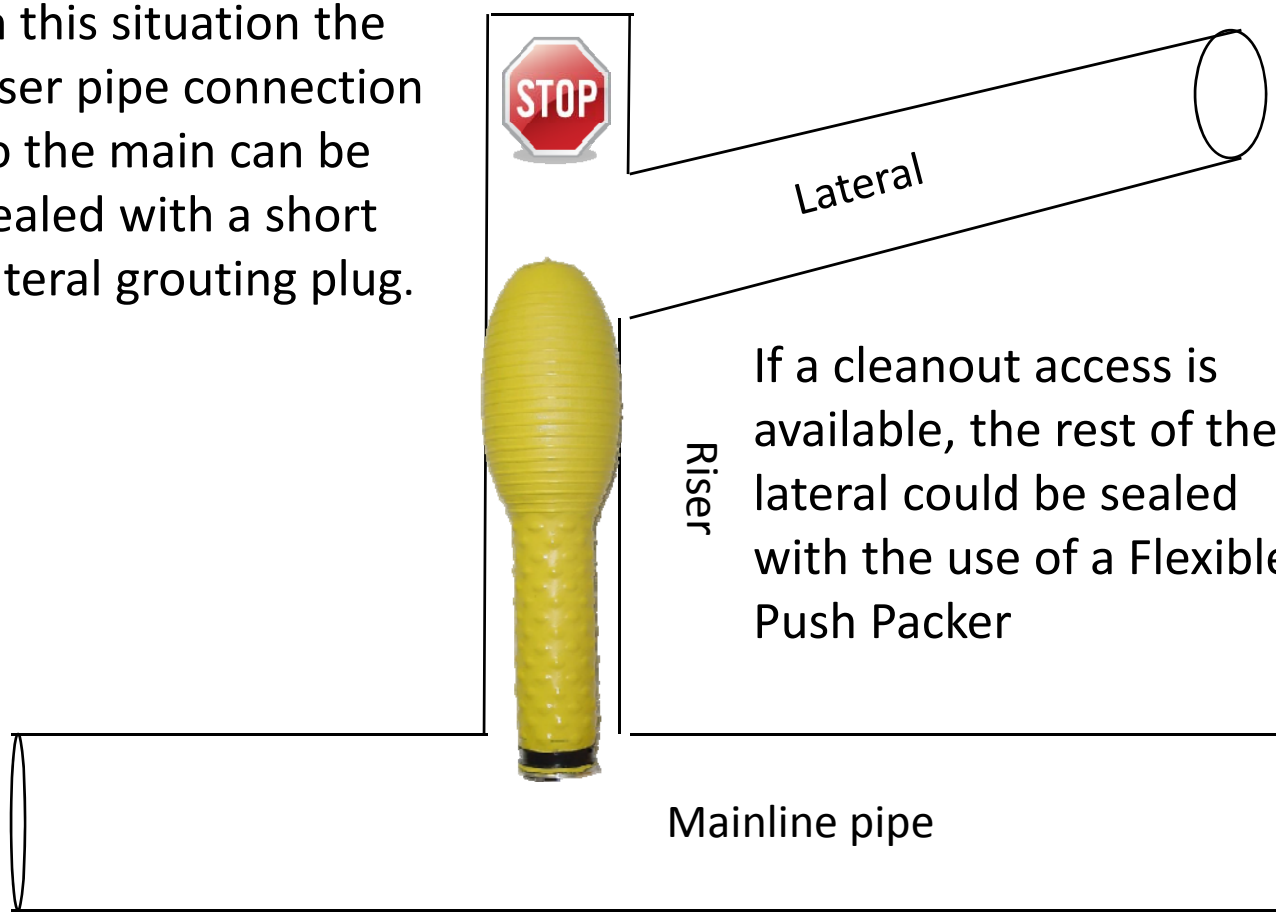
Special lateral Configurations



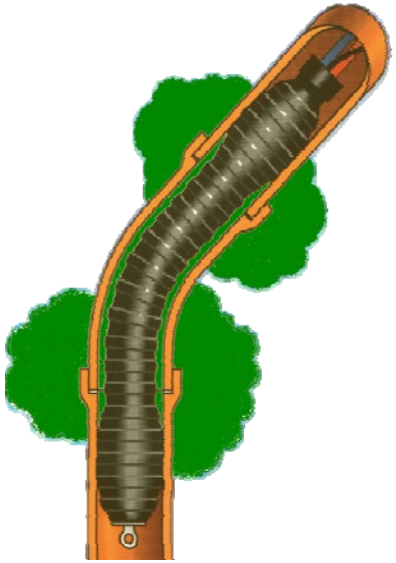
Only the common trunk can be sealed unless it can be confirmed which direction the lateral plug has taken during the inversion.

Special lateral Configurations

In this situation the riser pipe connection to the main can be sealed with a short lateral grouting plug.

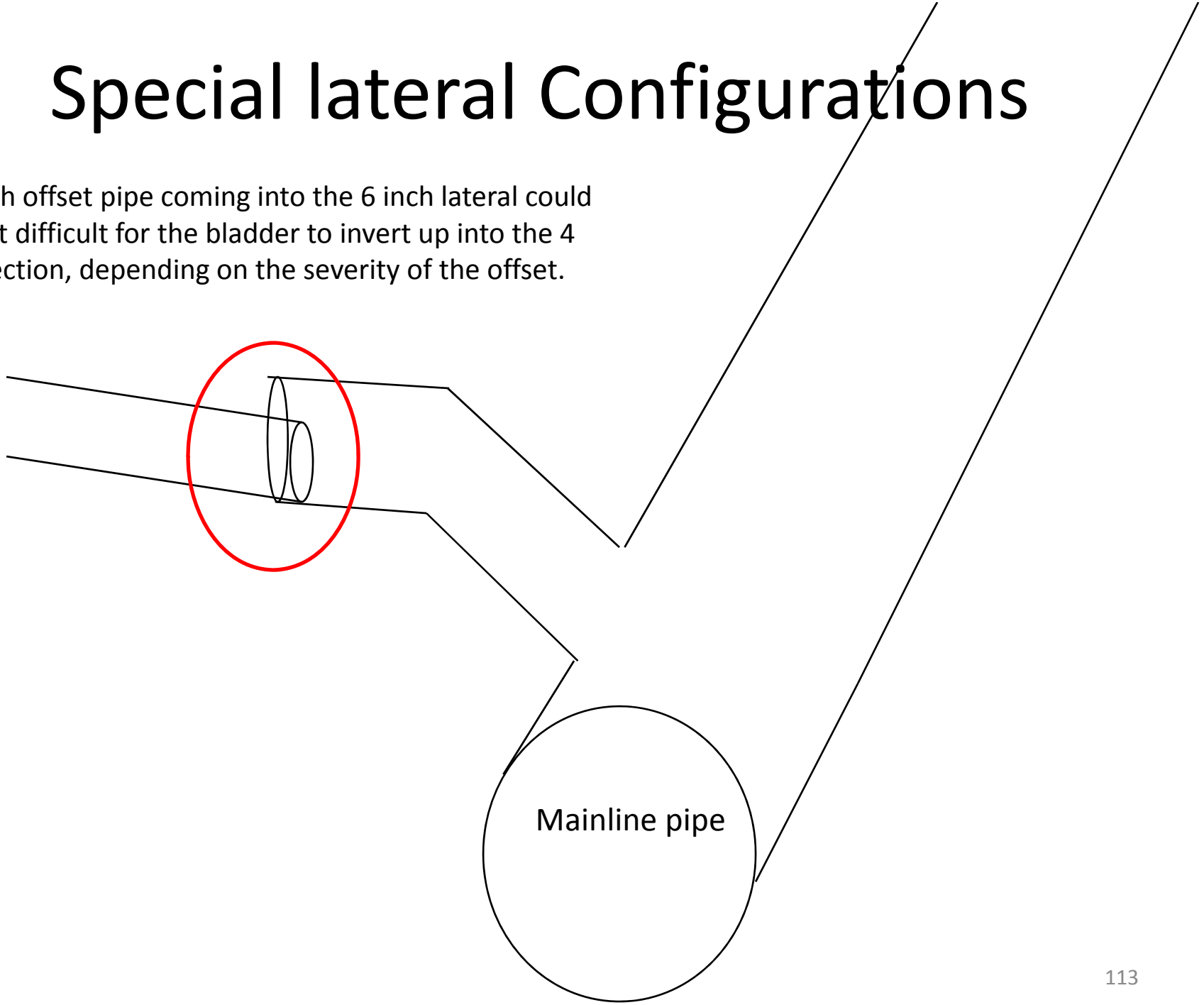


If a cleanout access is available, the rest of the lateral could be sealed with the use of a Flexible Push Packer



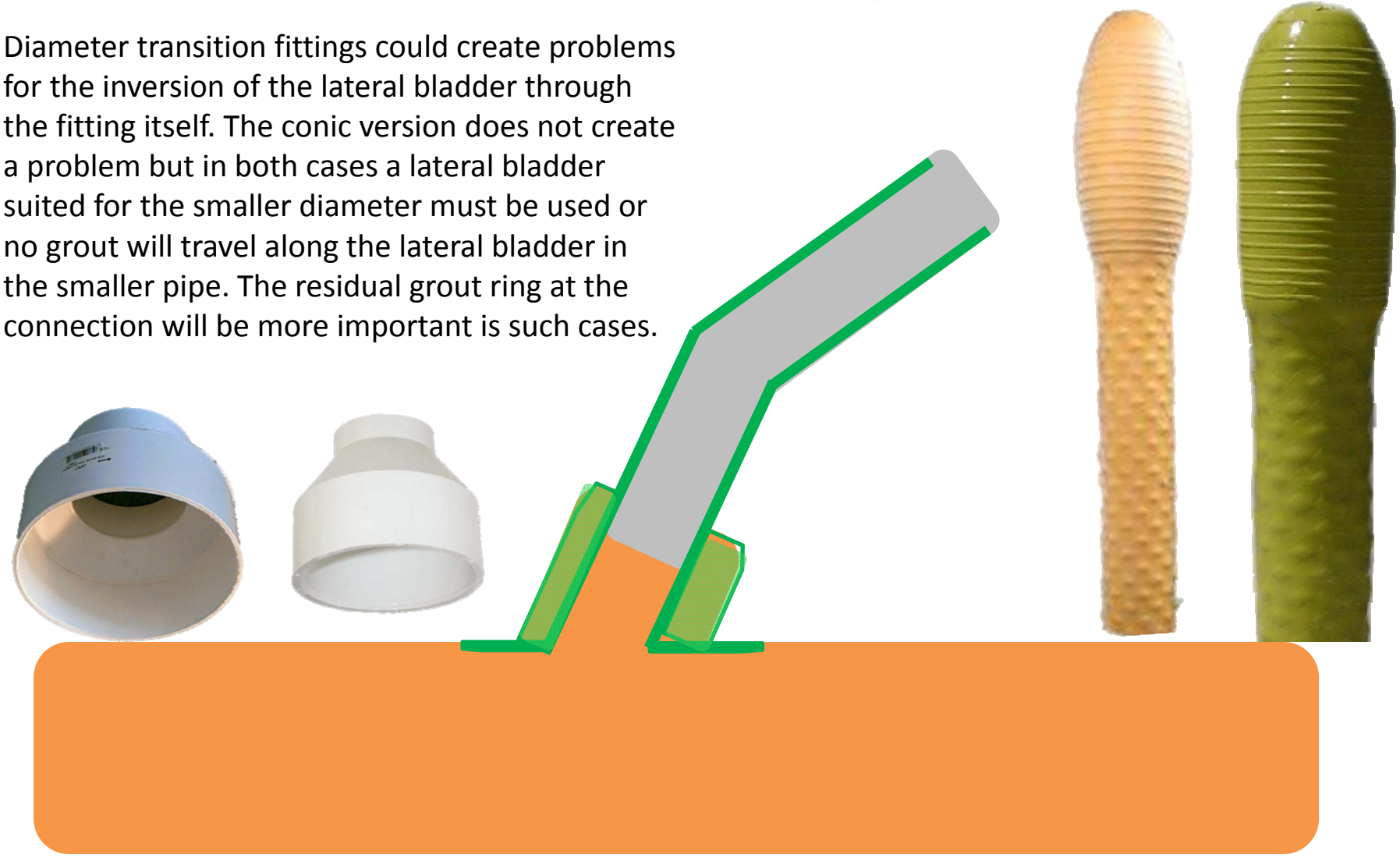
Special lateral Configurations

A 4 inch offset pipe coming into the 6 inch lateral could make it difficult for the bladder to invert up into the 4 inch section, depending on the severity of the offset.

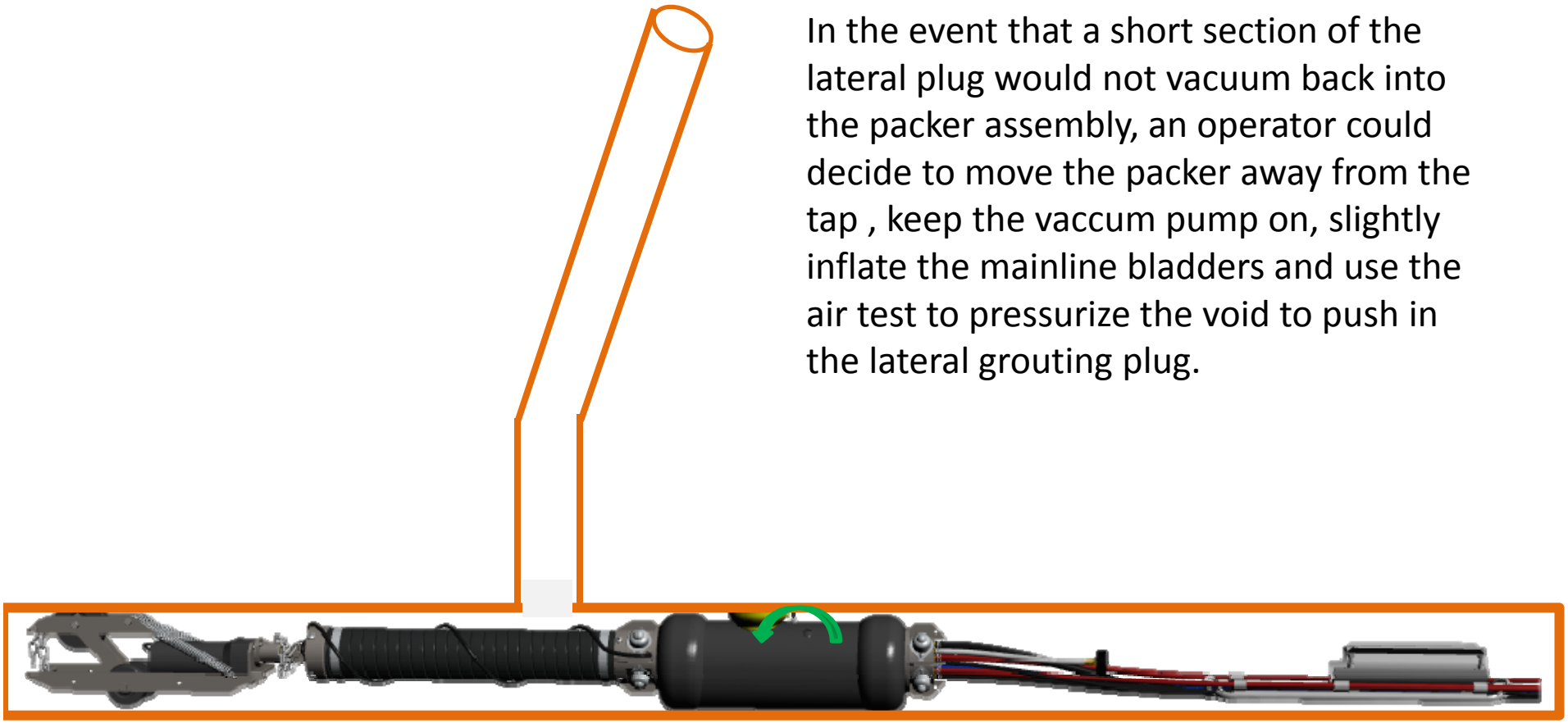


Special lateral Configurations

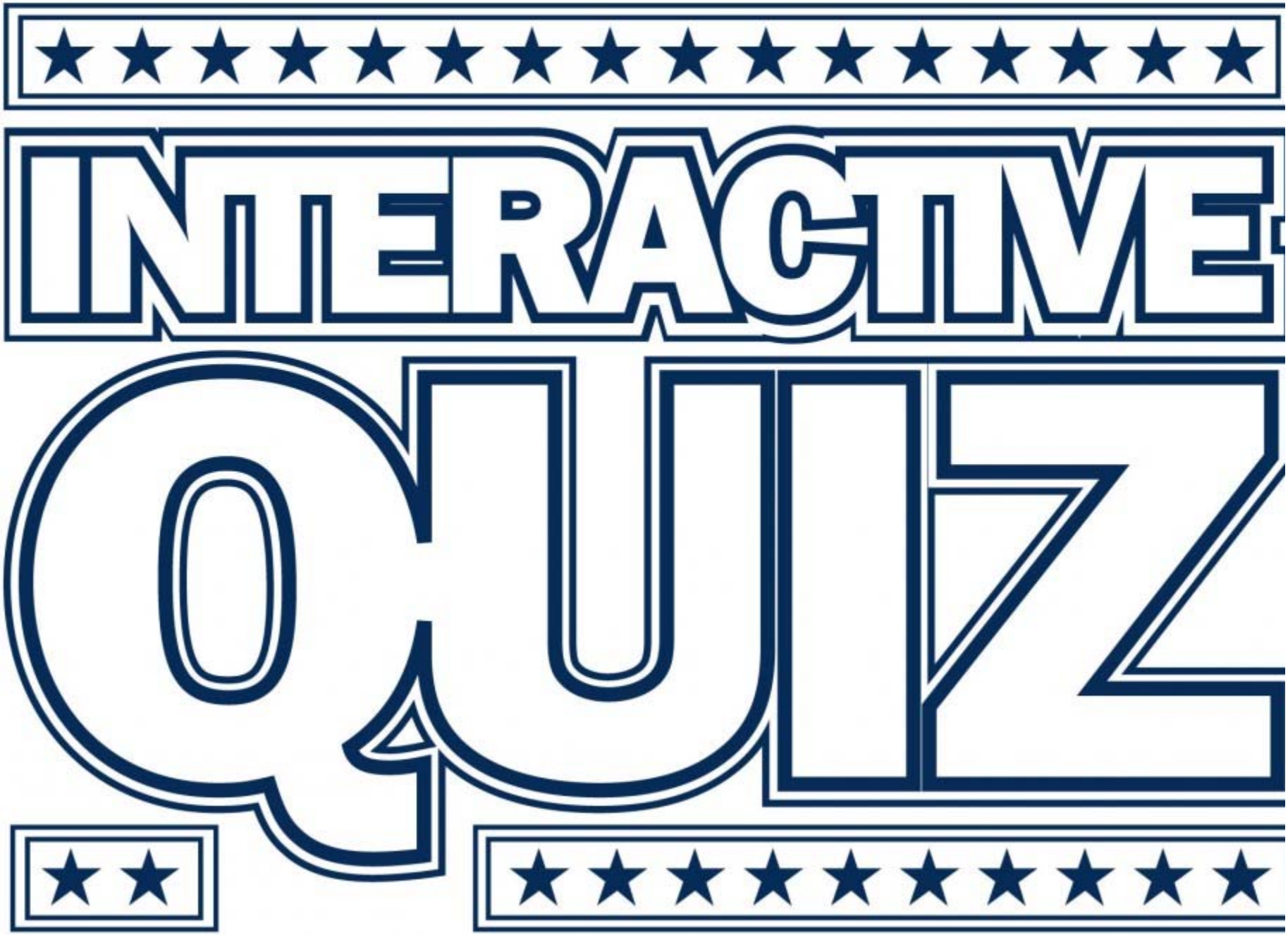
Diameter transition fittings could create problems for the inversion of the lateral bladder through the fitting itself. The conic version does not create a problem but in both cases a lateral bladder suited for the smaller diameter must be used or no grout will travel along the lateral bladder in the smaller pipe. The residual grout ring at the connection will be more important is such cases.



Lateral grouting plug vacuum helping hand



In the event that a short section of the lateral plug would not vacuum back into the packer assembly, an operator could decide to move the packer away from the tap , keep the vaccum pump on, slightly inflate the mainline bladders and use the air test to pressurize the void to push in the lateral grouting plug.


INTERACTIVE
QUIZ

Interactive Quiz—Group Answers

1. On a grout truck, how many feet of 5-part, color-coded hose is on the grout reel?

2. Mainline packers are available up to what size pipe?

3. What is the longest length of effective sealing distance performed with a lateral packer?

Time for a Break!

Let's take 10 minutes

Introduction to Complementary Technologies

CIPP Lining

Sectional Lining

Fold & Form Lining

Pipe Coatings

Manhole coatings

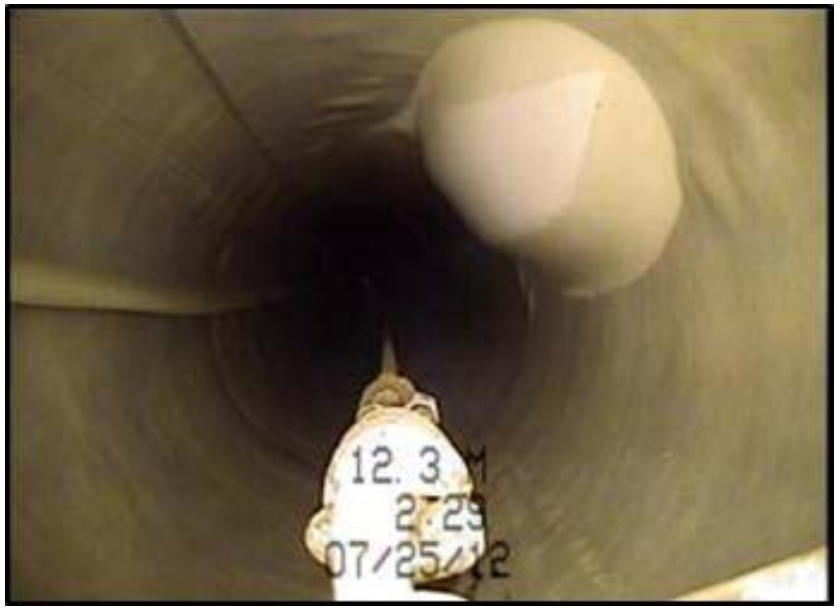
Pipe Bursting

Sliplining

Cast in Place

Injection grouting with complimentary technologies (pre-installation)

In the presence of active infiltration, Grouting before lining can help obtain better end results



Injection grouting with complimentary technologies (post-installation)

Complimentary Technologies

What to expect in Module 11:

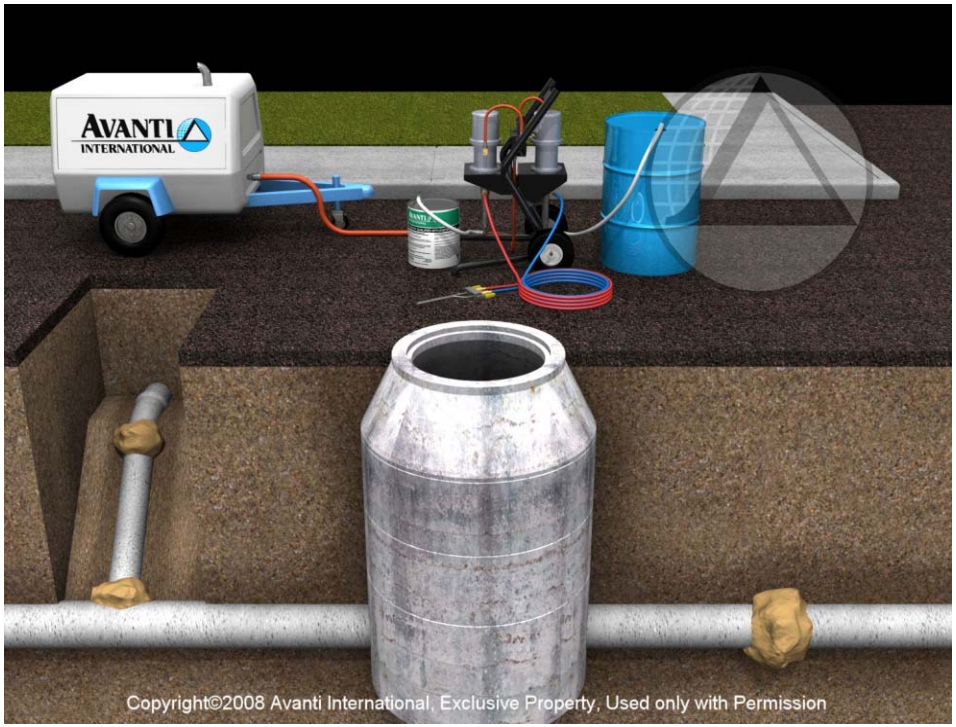
- Structural vs. Non-Structural pipe repairs
- Why grout is complimentary to many structural technologies
- The importance of stopping water intrusion prior to lining


Complimentary Technology

Complementary Technology Video
Module 11

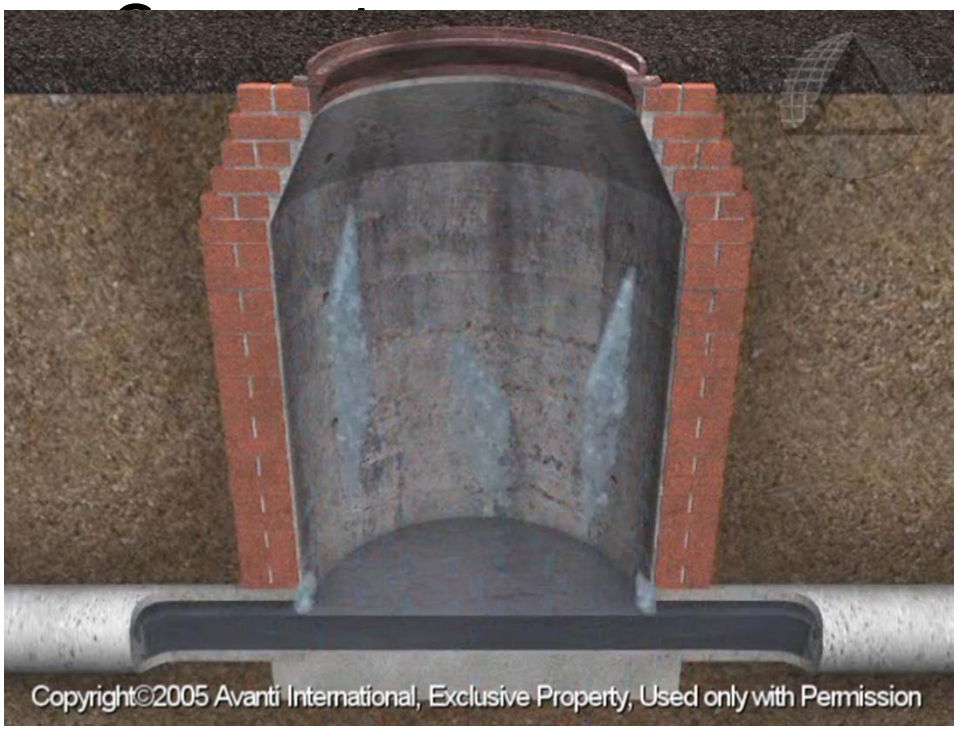
Low Hanging Fruit of I&I

- **First Defense for Sealing the System**
  - Easy Access
  - Vulnerable to Defects
    - Cracks
    - Pipe insertions
    - Faulty seals
    - Step inserts
    - Lifting holes



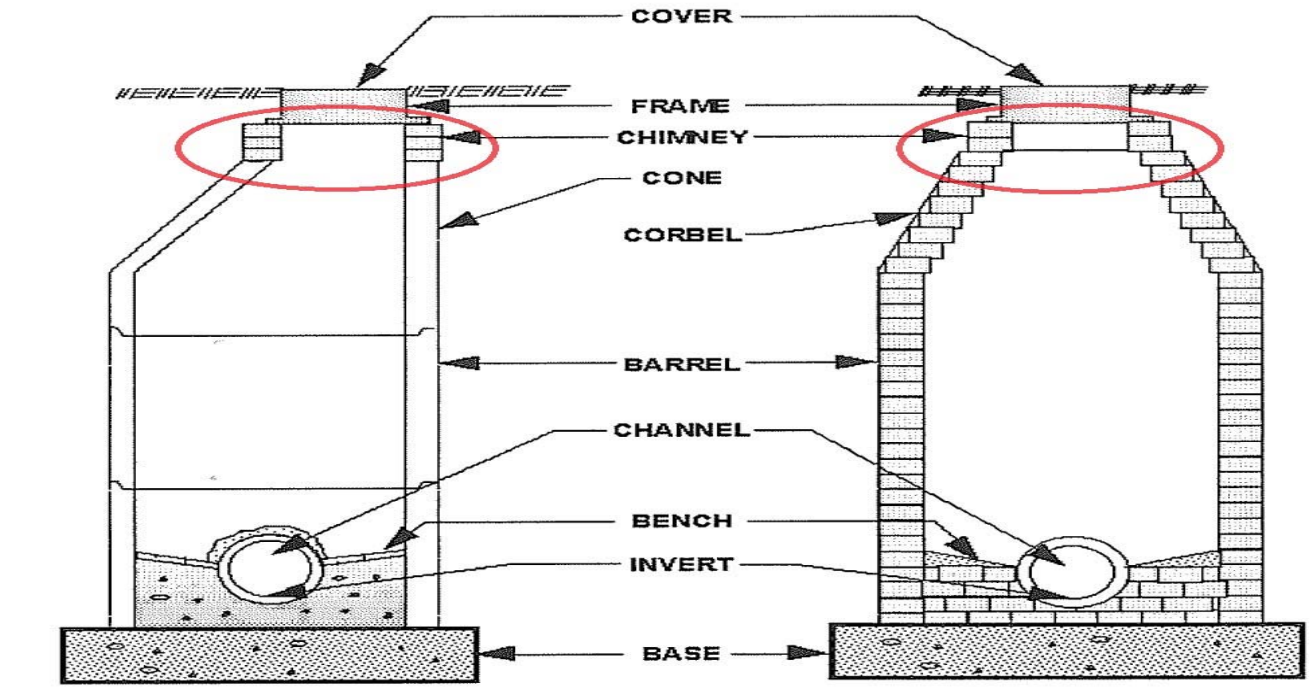
Types of Manholes

Brick and Mortar



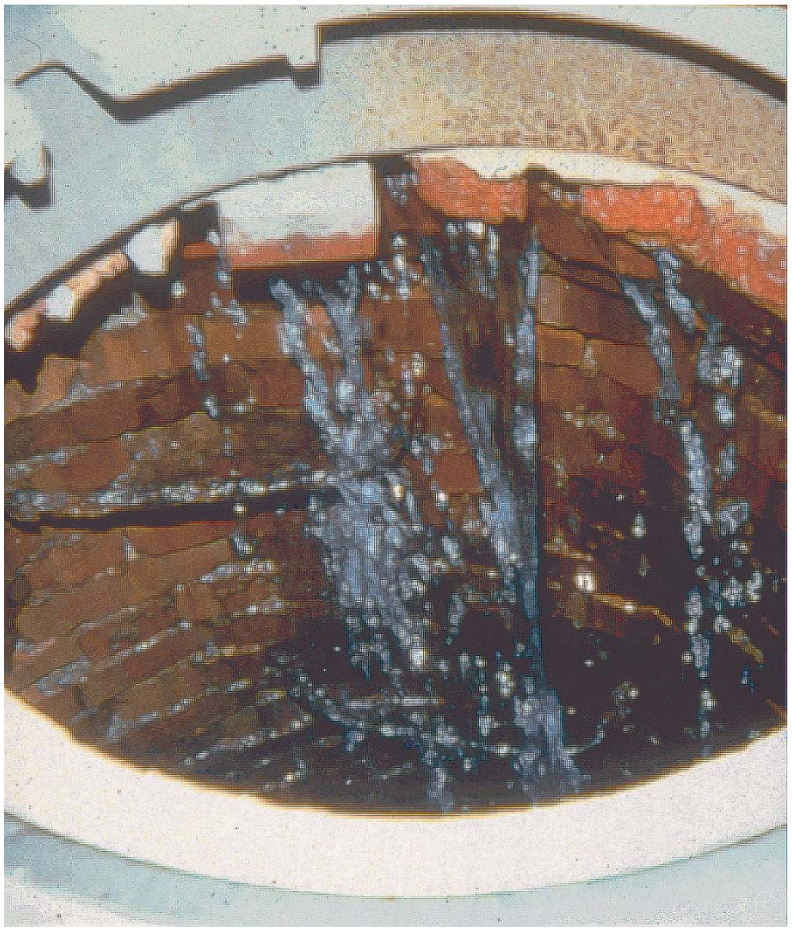
Pre-cast

Sources of Inflow in Manholes



BASIC MANHOLE COMPONENTS

Sources of Inflow in Manholes



Sources of Inflow in Manholes

Most exposure to the elements

Damage from Freeze/Thaw cycle

Constant Auto/Truck Traffic and Loads

Sources of Inflow in Manholes

Sources of Infiltration in Manholes

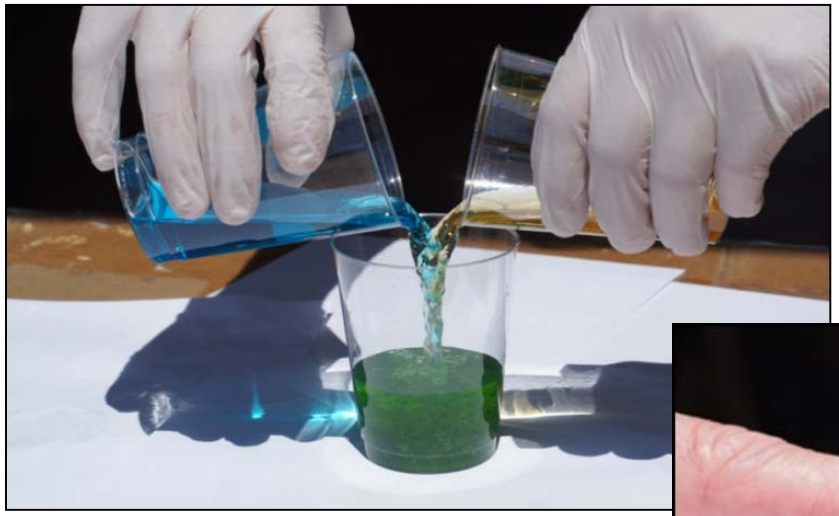
Techniques for Sealing Manholes

What to expect in **Module 12**:

- Why manholes are referred to as “low hanging fruit”
- What factors contribute a considerable amount of infiltration in manholes
- The five techniques and applications to grouting manholes – brick/mortar and pre-cast

Techniques for Sealing Manholes
Module 12

Demo & Discussion
Acrylic vs Urethane for Manholes



Injection Grouting Manholes

First Defense for MH Rehabilitation

- As a **stand-alone** solution
- Least cost, high return-on-effort
- Reduce flow & cost of I&I
- Fill voids, extend lifecycle of structure

Injection Grouting Manholes

First Defense for MH Rehabilitation

- As part of a **multi-step** solution
- Step 1: stop active water leaks
- Required for cement lining, epoxy coating
- More durable, long-term solution

Chemical Mixing

What to expect in **Module 13**:

- The process of mixing Acrylamide grout components
- Why testing the mix via a ‘cup test’ is important
- Why additives change outcomes

Chemical Mixing
Module 13

Gel Strength

What to expect in Module 14:

- Gel strength of standard batch
- PSI – neat gel vs. gel/sand matrix
- Dilution of grout vs. Double batch

Gel Strength
Module 14

Chemical Safety

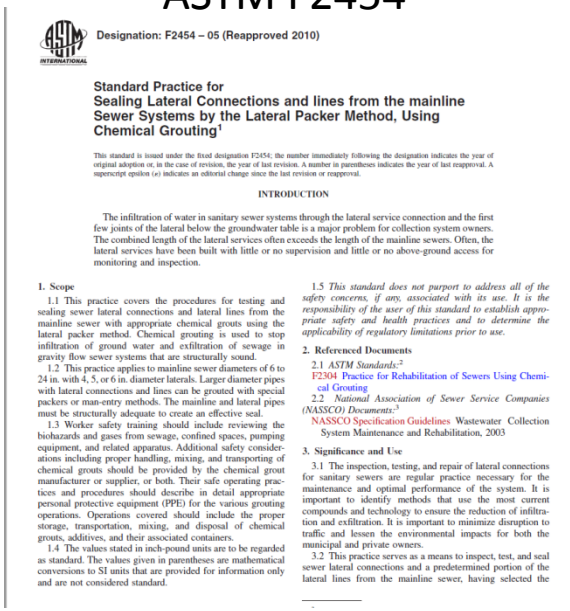
What to expect in Module 15:

- Why safety should always be a priority
- Acrylamide is a naturally occurring by-product in my foods we consume on a daily basis
- Education and knowledge are the best strategy to ensure a safe work environment

Chemical Safety
Module 15

Introduction to Standard Specifications

(Laterals)
ASTM F2454



Designation: F2454 – 05 (Reapproved 2010)

Standard Practice for Sealing Lateral Connections and lines from the mainline Sewer Systems by the Lateral Packer Method, Using Chemical Grouting[1]

This standard is issued under the fixed designation F2454; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

The infiltration of water in sanitary sewer systems through the lateral service connection and the first few joints of the lateral below the groundwater table is a major problem for collection system owners. The combined length of the lateral services often exceeds the length of the mainline sewers. Often, the lateral services have been built with little or no supervision and little or no above-ground access for monitoring and inspection.

1. Scope

1.1 This practice covers the procedures for testing and sealing sewer lateral connections and lateral lines from the mainline sewer with appropriate chemical grouts using the lateral packer method. Chemical grouting is used to stop infiltration of ground water and exfiltration of sewage in gravity flow sewer systems that are structurally sound.

1.2 This practice applies to mainline sewer diameters of 6 to 24 in. with 4, 5, or 6 in. diameter laterals. Larger diameter pipes with lateral connections and lines can be grouted with special packers or man-entry methods. The mainline and lateral pipes must be structurally adequate to create an effective seal.

1.3 Worker safety training should include reviewing the biohazards and gases from sewage, confined spaces, pumping equipment, and related apparatus. Additional safety considerations including proper handling, mixing, and transporting of chemical grouts should be provided by the chemical grout manufacturer or supplier, or both. Their safe operating practices and procedures should describe in detail appropriate personal protective equipment (PPE) for the various grouting operations. Operations covered should include the proper storage, transportation, mixing, and disposal of chemical grouts, additives, and their associated containers.

1.4 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]
F2304 Practice for Rehabilitation of Sewers Using Chemical Grouting

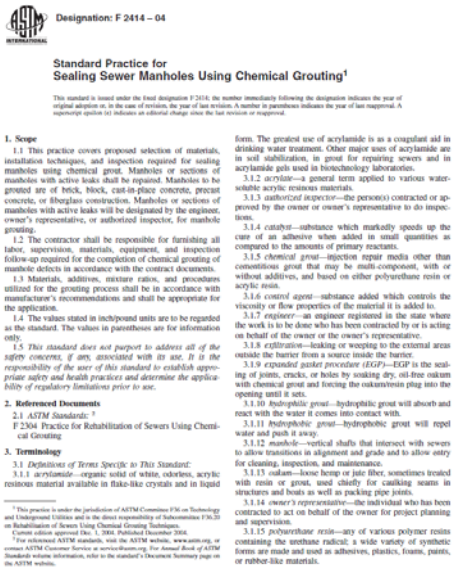
2.2 *National Association of Sewer Service Companies (NASSCO) Documents:*[3]
NASSCO Specification Guidelines Wastewater Collection System Maintenance and Rehabilitation, 2003

3. Significance and Use

3.1 The inspection, testing, and repair of lateral connections for sanitary sewers are regular practice necessary for the maintenance and optimal performance of the system. It is important to identify methods that use the most current compounds and technology to ensure the reduction of infiltration and exfiltration. It is important to minimize disruption to traffic and lessen the environmental impacts for both the municipal and private owners.

3.2 This practice serves as a means to inspect, test, and seal sewer lateral connections and a predetermined portion of the lateral lines from the mainline sewer, having selected the

Manholes
ASTM F2414



Designation: F 2414 – 04

Standard Practice for Sealing Sewer Manholes Using Chemical Grouting[1]

This standard is issued under the fixed designation F 2414; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers proposed selection of materials, installation techniques, and inspection required for sealing manholes using chemical grout. Manholes or sections of manholes with active leaks shall be repaired. Manholes to be grouted are of brick, block, cast-in-place concrete, precast concrete, or fiberglass construction. Manholes or sections of manholes with active leaks will be designated by the engineer, owner's representative, or authorized inspector, for manhole grouting.

1.2 The contractor shall be responsible for furnishing all labor, supervision, materials, equipment, and inspection follow-up required for the completion of chemical grouting of manhole defects in accordance with the contract documents.

1.3 Materials, additives, mixture ratios, and procedures utilized for the grouting process shall be in accordance with manufacturer's recommendations and shall be appropriate for the application.

1.4 The values stated in inch/pound units are to be regarded as the standard. The values in parentheses are for information only.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [3]
F 2304 Practice for Rehabilitation of Sewers Using Chemical Grouting

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *acrylamide*—organic solid of white, odorless, acrylic resinous material available in flake-like crystals and in liquid form. The greatest use of acrylamide is as a coagulant aid in drinking water treatment. Other major uses of acrylamide are in soil stabilization, in grout for repairing sewers and in acrylamide gels used in biotechnology laboratories.

3.1.2 *acrylate*—a general term applied to various water-soluble acrylic resinous materials.

3.1.3 *authorized inspector*—the person(s) contracted or approved by the owner or owner's representative to do inspections.

3.1.4 *catalyst*—substance which markedly speeds up the cure of an adhesive when added in small quantities as compared to the amounts of primary reactants.

3.1.5 *chemical grout*—injection repair media other than conventitious grout that may be multi-component, with or without additives, and based on either polyurethane resin or acrylic resin.

3.1.6 *control agent*—substance added which controls the viscosity or flow properties of the material it is added to.

3.1.7 *engineer*—an engineer registered in the state where the work is to be done who has been contracted by or is acting on behalf of the owner or the owner's representative.

3.1.8 *exfiltration*—leaking or weeping to the external areas outside the barrier from a source inside the barrier.

3.1.9 *expanded gasket procedure (EGP)*—EGP is the sealing of joints, cracks, or holes by soaking dry, oil-free oakum with chemical grout and forcing the oakum/resin plug into the opening until it sets.

3.1.10 *hydrophilic grout*—hydrophilic grout will absorb and react with the water it comes into contact with.

3.1.11 *hydrophobic grout*—hydrophobic grout will repel water and push it away.

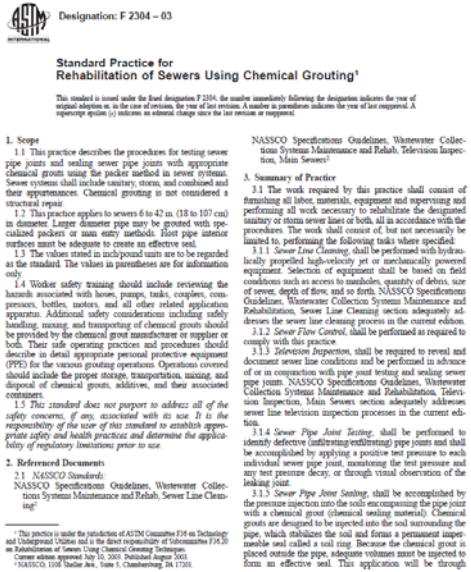
3.1.12 *manhole*—vertical shafts that intersect with sewers to allow transitions in alignment and grade and to allow entry for cleaning, inspection, and maintenance.

3.1.13 *oakum*—loose hemp or jute fiber, sometimes treated with resin or grout, used chiefly for caulking seams in structures and boats as well as packing pipe joints.

3.1.14 *owner's representative*—the individual who has been contracted to act on behalf of the owner for project planning and supervision.

3.1.15 *polyurethane resin*—any of various polymer resins containing the urethane radical; a wide variety of synthetic forms are made and used as adhesives, plastics, foams, paints, or rubber-like materials.

Mainline Joints
ASTM F2304



Designation: F 2304 – 03

Standard Practice for Rehabilitation of Sewers Using Chemical Grouting[1]

This standard is issued under the fixed designation F 2304; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice describes the procedures for testing sewer pipe joints and sealing sewer pipe joints with appropriate chemical grouts using the packer method in sewer systems. Sewer systems shall include sanitary, storm, and combined and their appurtenances. Chemical grouting is not considered a structural repair.

1.2 This practice applies to sewers 6 to 42 in. (18 to 107 cm) in diameter. Larger diameter pipe may be grouted with specialized packers or man entry methods. Host pipe interior surfaces must be adequate to create an effective seal.

1.3 The values stated in inch/pound units are to be regarded as the standard. The values in parentheses are for information only.

1.4 Worker safety training should include reviewing the hazards associated with hoses, pumps, tanks, couplers, compressors, bottles, motors, and all other related application apparatus. Additional safety considerations including safely handling, mixing, and transporting of chemical grouts should be provided by the chemical grout manufacturer or supplier or both. Their safe operating practices and procedures should describe in detail appropriate personal protective equipment (PPE) for the various grouting operations. Operations covered should include the proper storage, transportation, mixing, and disposal of chemical grouts, additives, and their associated containers.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *NASSCO Standards:*
NASSCO Specifications Guidelines, Wastewater Collections Systems Maintenance and Rehab, Sewer Line Cleaning[2]

NASSCO Specifications Guidelines, Wastewater Collections Systems Maintenance and Rehab, Television Inspection, Main Sewers[2]

3. Summary of Practice

3.1 The work required by this practice shall consist of furnishing all labor, materials, equipment and supervising and performing all work necessary to rehabilitate the designated sanitary or storm sewer lines or both, all in accordance with the procedures. The work shall consist of, but not necessarily be limited to, performing the following tasks where specified:

3.1.1 *Sewer Line Cleaning*, shall be performed with hydraulically propelled high-velocity jet or mechanically powered equipment. Selection of equipment shall be based on field conditions such as access to manholes, quantity of debris, size of sewer, depth of flow, and so forth. NASSCO Specifications Guidelines, Wastewater Collection Systems Maintenance and Rehabilitation, Sewer Line Cleaning section adequately addresses the sewer line cleaning process in the current edition.

3.1.2 *Sewer Flow Control*, shall be performed as required to comply with this practice.

3.1.3 *Television Inspection*, shall be required to reveal and document sewer line conditions and be performed in advance of or in conjunction with pipe joint testing and sealing sewer pipe joints. NASSCO Specifications Guidelines, Wastewater Collection Systems Maintenance and Rehabilitation, Television Inspection, Main Sewers section adequately addresses sewer line television inspection processes in the current edition.

3.1.4 *Sewer Pipe Joint Testing*, shall be performed to identify defective (infiltrating/exfiltrating) pipe joints and shall be accomplished by applying a positive test pressure to each individual sewer pipe joint, monitoring the test pressure and any test pressure decay, or through visual observation of the leaking joint.

3.1.5 *Sewer Pipe Joint Sealing*, shall be accomplished by the pressure injection into the soils encompassing the pipe joint with a chemical grout (chemical sealing material). Chemical grouts are designed to be injected into the soil surrounding the pipe, which stabilizes the soil and forms a permanent impermeable seal called a soil ring. Because the chemical grout is placed outside the pipe, adequate volumes must be injected to form an effective seal. This application will be through

Standard Specifications

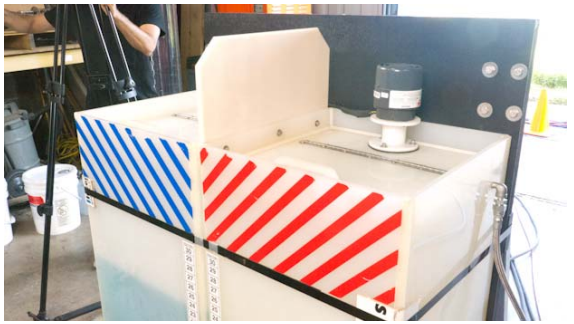
What to expect in Module 16:

- Why standards and specifications for grouting exist
- How to insure accuracy, integrity and performance capabilities
- Characteristic requirements for all grout materials

Standard Specifications
Module 16

Solution Grout Mix

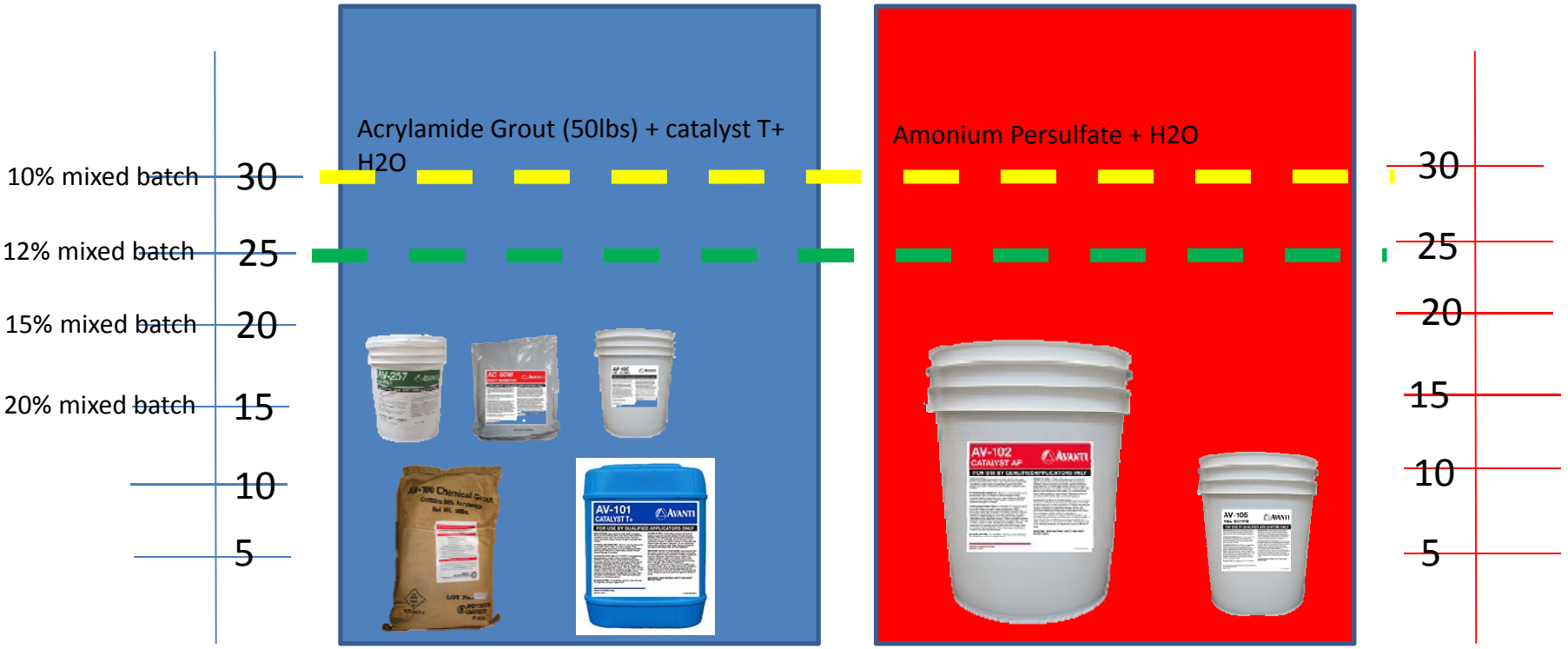
Most of the grouts being pumped through remotely operated packers are solution grouts (acrylamides, acrylates or acrylics)



Latex strengthening agent

Root Inhibitor

Gel Guard

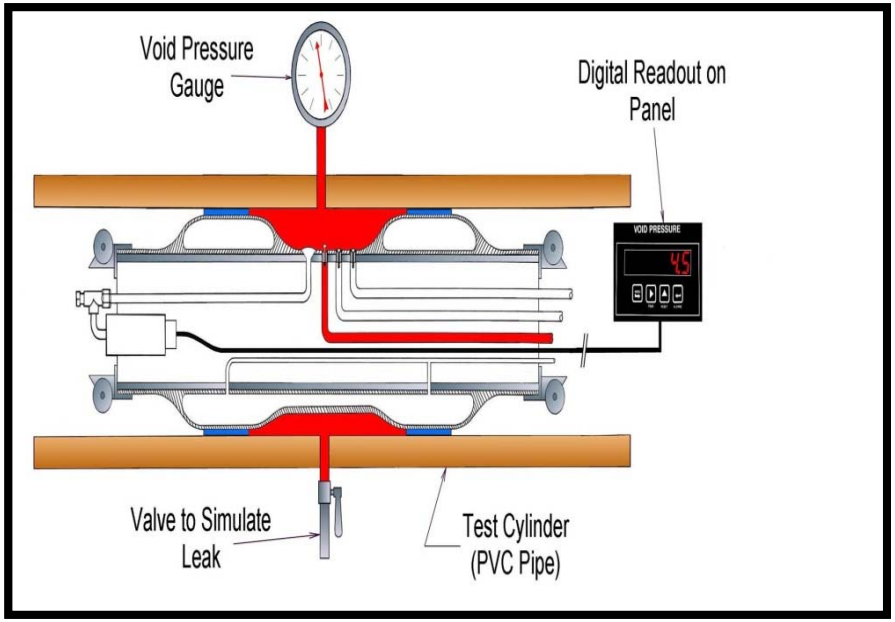


(Ex: Acrylamide Grout Solution)

DS1

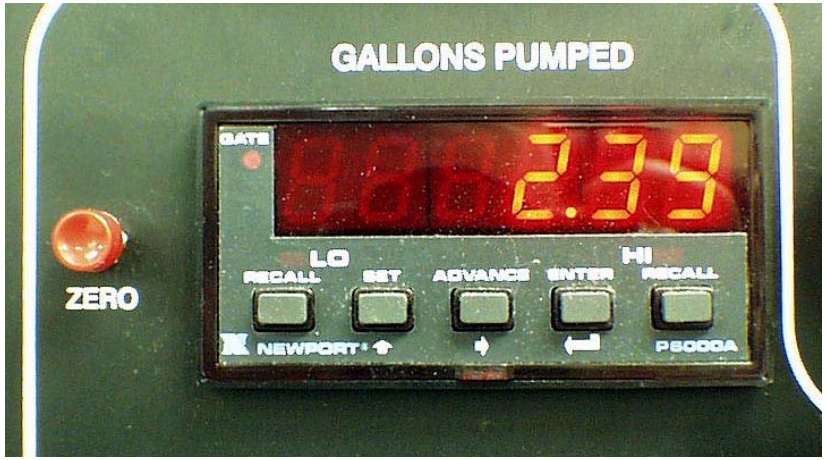
Nassco Suggested Standard Specification for pressure testing and grouting of sewer pipe joints, laterals and lateral connections using the packer method with solution grouts (2014)

- Part 3.1 Control Tests
  - A .Packer Tests - Demonstrate the acceptable performance of air test.
  - To insure the accuracy, integrity and performance capabilities of the testing equipment, a demonstration test will be performed in an above-ground 8” nominal diameter test cylinder suitable to contain the full length of the packer and sustain the void test pressure. The test cylinder shall be equipped with a void release valve to exercise a controlled release of pressurized air from the void area to test the packer under both sound and leaking conditions. The test cylinder shall also be equipped with a local pressure gauge (0-25 psi) within the void space



Nassco Suggested Standard Specification for pressure testing and grouting of sewer pipe joints, laterals and lateral connections using the packer method with solution grouts (2014)

- Pump Tests
  - At the beginning of the contract, prior to application of grout, perform a pump test to determine if proper ratios are being pumped from the grout component tanks at the proper rates and to measure pump rates. Use separate containers to capture the discharges from each of the grout component hoses, to simulate the actual volumes of each component through the interconnect hoses, hose reel and length of grout hose and confirm accuracy of grout pump totalizer. Take corrective action if ratios or rates are not within manufacturer's recommended standards.



Nassco Suggested Standard Specification for pressure testing and grouting of sewer pipe joints, laterals and lateral connections using the packer method with solution grouts (2014)

- Gel times shall be calculated using the following formula unless CONTRACTOR experience and/or field conditions dictate otherwise. Any alterations of the gel time formula shall be approved by the ENGINEER.

$$Gel\ Time = \left(\frac{Volume\ of\ Pipe / Packer\ Void\ Space\ (gal)}{Pumping\ Rate\ (gpm)} \right) \left(\frac{60\,\text{sec}}{1\,\text{min}} \right) + 20\,\text{sec}(+/-5\,\text{sec})$$

  - Packer/Pipe void shall be defined as the volume between the inflated packer and the inside pipe wall when the packer is inflated per manufacturer recommendations.

For example: an 8” pipe with a packer void space of 0.3 gallons and a 3 gpm pumping rate would provide

$$Gel\ Time = \left(\frac{Volume\ of\ Pipe/Packer\ Void\ Space\ (gal)}{Pumping\ Rate\ (gpm)}\right)\left(\frac{60\,\text{sec}}{1\,\text{min}}\right) + 20\,\text{sec}(+/-5\,\text{sec})$$

$$Gel\ Time = \left(\frac{.3(gal)}{3(gpm)}\right)\left(\frac{60\,\text{sec}}{1\,\text{min}}\right) + (20\,\text{sec}) = 26\,\text{sec}(+/-5\,\text{sec})$$

Time required to fill this void is 6 seconds. Suggested gel time window in this case is 21-31 seconds.

Gel Times of the Grouts

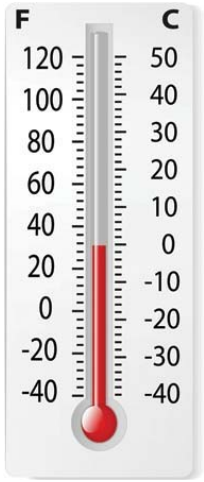
Standard cup test for gel time verification

Dilution affects gel times

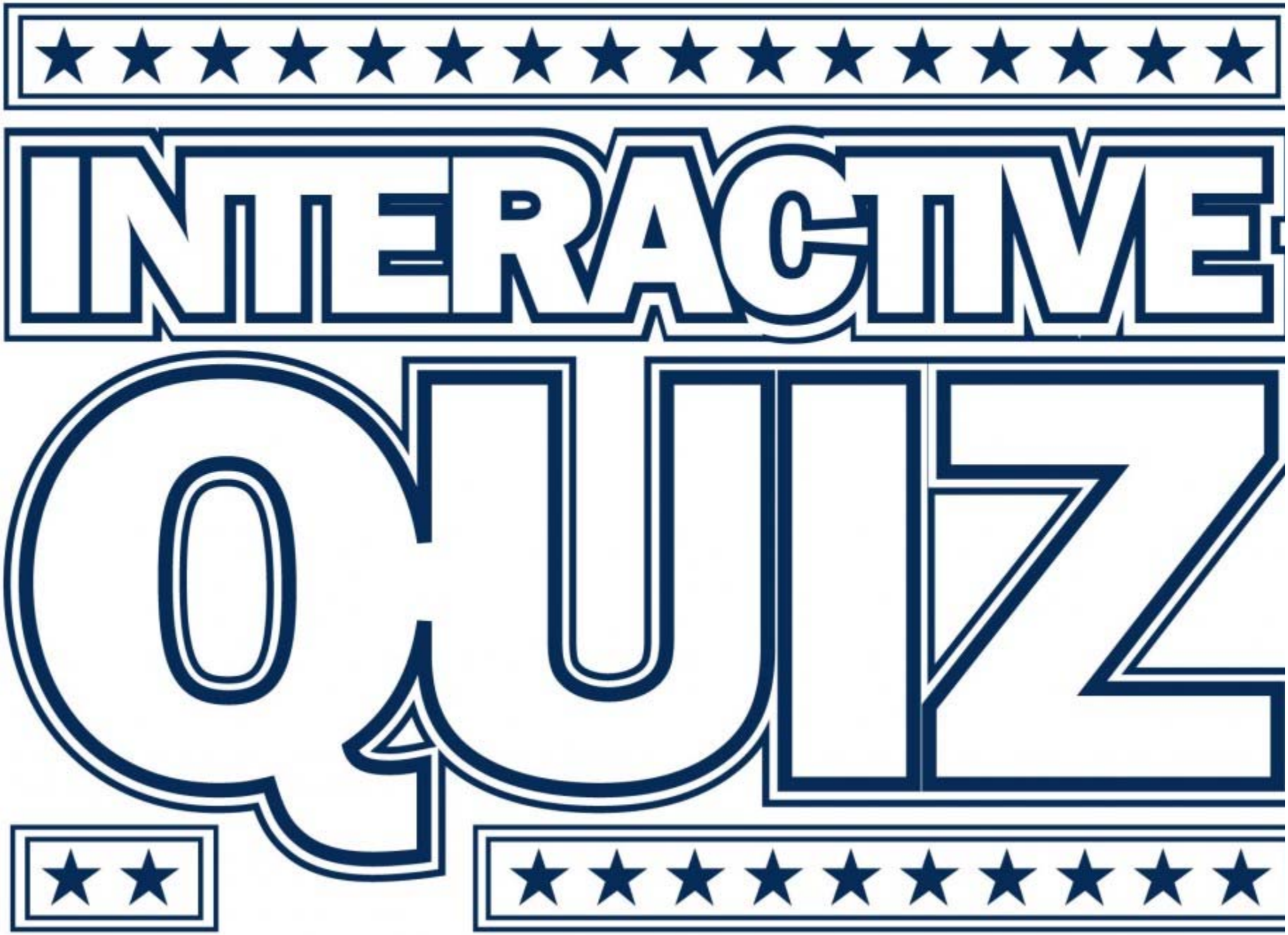
Pump delivery system ex: 3 gpm

Grout hose recirculation when necessary

Gel times of the grouts are affected by temperature & dilution. The colder it is the longer it takes for the grout to react & vice versa. The mixed grout pumped into bodies of water will usually take more time to react into a gel.



- A good set of Specifications for Lateral Sealing must include;
  - Grout concentration mix & additives required
  - Gel times vs pumping rates in relation to packer/pipe void
  - Effective sealing distances required in the lateral
  - Preparation of the lateral (pre cleaning and cctv if necessary)
  - Mainline & Lateral diameter and any transitions
  - Number of laterals within each reach or setup
  - Bid tab for gallons of grout pumped (ex: step grouting procedure in increments of 2-3 gallons)
  - Pre/Post testing
  - Bid tab for post cleaning of residual or excess grout (two different items)


INTERACTIVE
QUIZ

Interactive Quiz—Group Answers

1. T/F: Injection grouting is complementary to all other trenchless technologies?

2. A 10 degree increase in temperature has what affect on gel-time?

2. Unless approved by the engineer, what is the maximum number of stages in step grouting?

Summary of all presentations

- 16 module series is meant to introduce/educate all participants,(contractors, municipalities & engineers) on municipal grouting
- Knowing and undserstanding your collection system and prioritizing basins for rehabilitation is a good start.
- Must be a Holistic approach (Mainline joints, manholes, lateral taps & lateral portion)
- Pre & post rehabilitation flow monitoring will confirm your ROI
- In order to have successful grouting projects all levels (design, execution & inspection/QC) must have a very good understanding of the technology (chemistry & delivery)
- A grout first approach may be right for your system
- Municipal grouting may not be the answer for every defect out there, but it will work well on its own in structurally sound structures and will help other rehab techologies control unwanted infiltration during or post installation for optimal results.


GOOD JOB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