

April 7, 2025

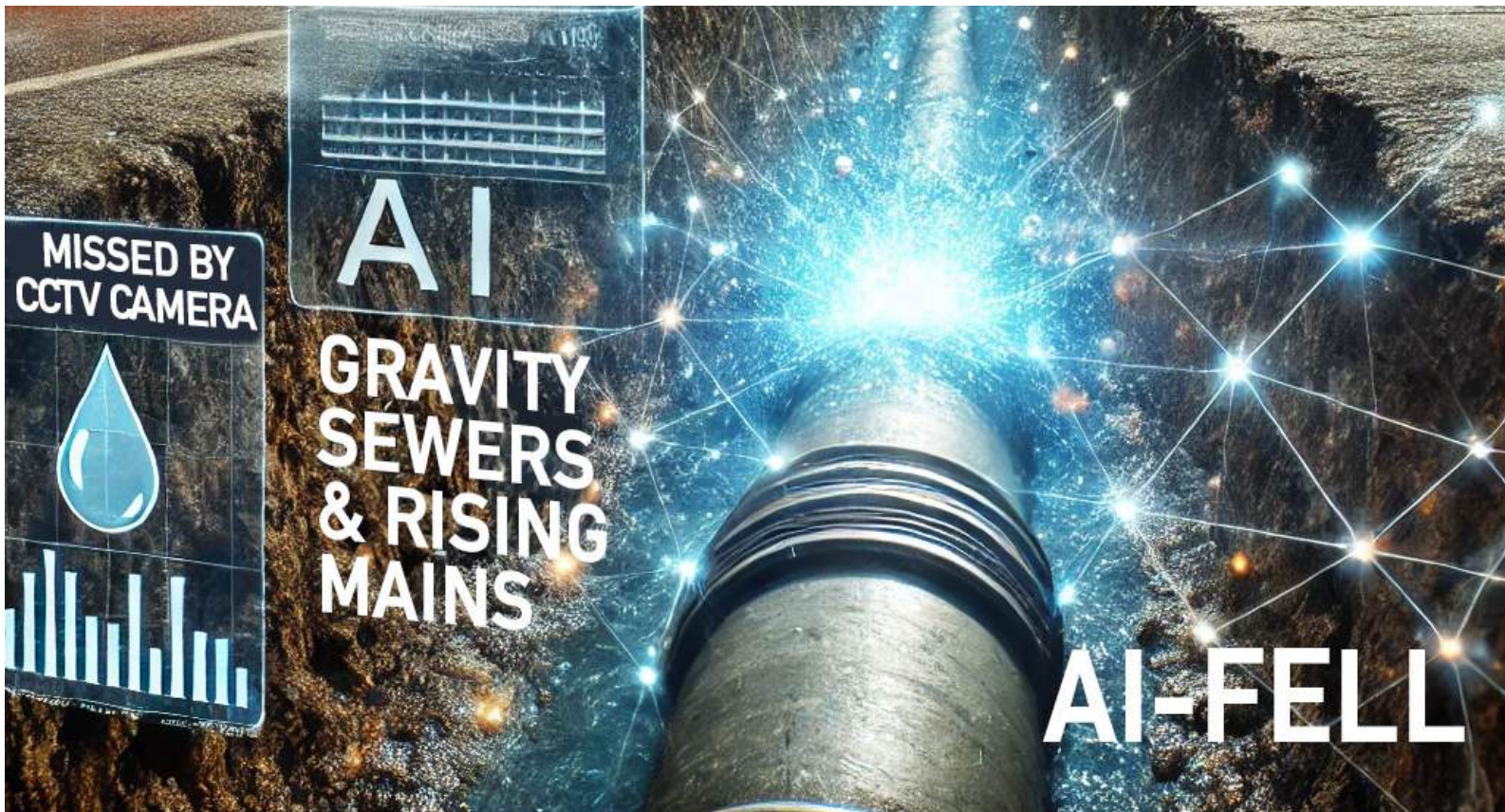
NEWS

BREAKING NEWS

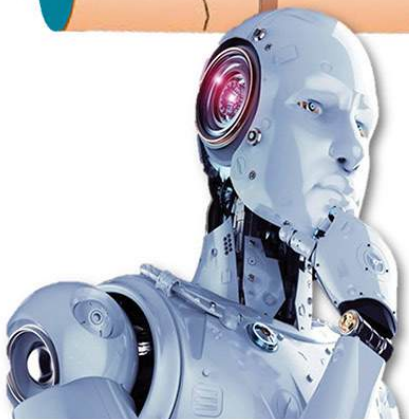
21:00

Sewer Project Finds Post-CIPP Increased Infiltration

4-Year Project Finds CCTV Unable to Assess Sewers for Repair or Rehab



CCTV Cameras Can't Tell if Cracks or Bad Joints Leak Through Pipe Wall Leading to Poor Repair Decisions.



AI CAN'T SEE WHAT CCTV CAN'T SEE!

New Tech Was Needed to Evaluate 100% of Pipe Wall.

4-Year Sewer Study Measures 63% Increase in Infiltration After CIPP

89 Sewer Mains or 25,822 Linear Ft. Study Compares CCTV v. FELL in Test of Pre- and Post-Rehabilitation Effectiveness

CCTV

Closed Circuit Television

Inaccurate, Error-Prone, Inconsistent, Not Repeatable, No Leakage Measurements, Can't 'See' Defects in CIPP Liners

FALSE-POSITIVE READINGS CALL 'BAD CIPP' AS 'GOOD.'



Using NASSCO PACP® Coding, CCTV Operators Identified Only 23 Pre-Rehabilitation Structural, Maintenance, and Operational Defects. and ZERO (0) Post-Rehabilitation Defects.

FELL

Focused Electrode Leak Location



Fast, Accurate, Unbiased

Pre-Rehabilitation Assessment By Number of Defects

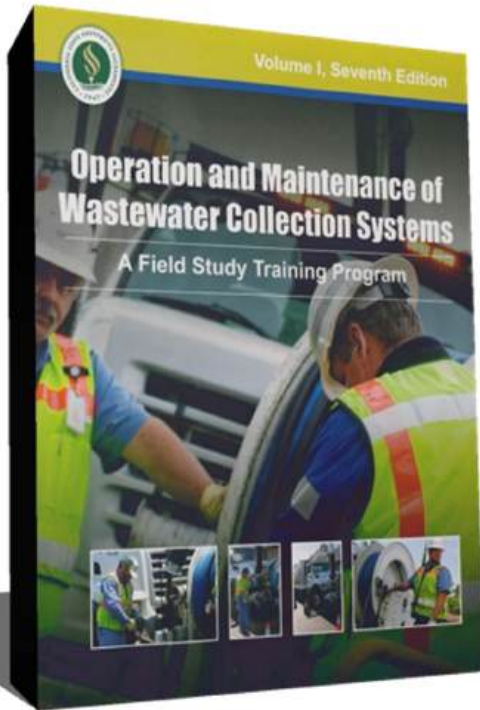
25,822 Linear Feet

283 Service Connections

CCTV PACP Results	FELL Results	CCTV PACP Results	FELL Results
29	1,719	5	178

O&M Wastewater Collection System Manual, Vol. 1

ISBN 978-1-59371-066-8



Separate scans should be taken before and after any pipe repair, relining, or rehabilitation activity to compare electrode current values and to determine if any visual defects were missed during initial assessment.
Section 4.432, Page 247.

2015 Ken Kerri, Ph.D., P.E.



“CAMERAS MISS 80-100% OF LEAKS.”

Ken Kerri, Ph.D., P.E.
2010

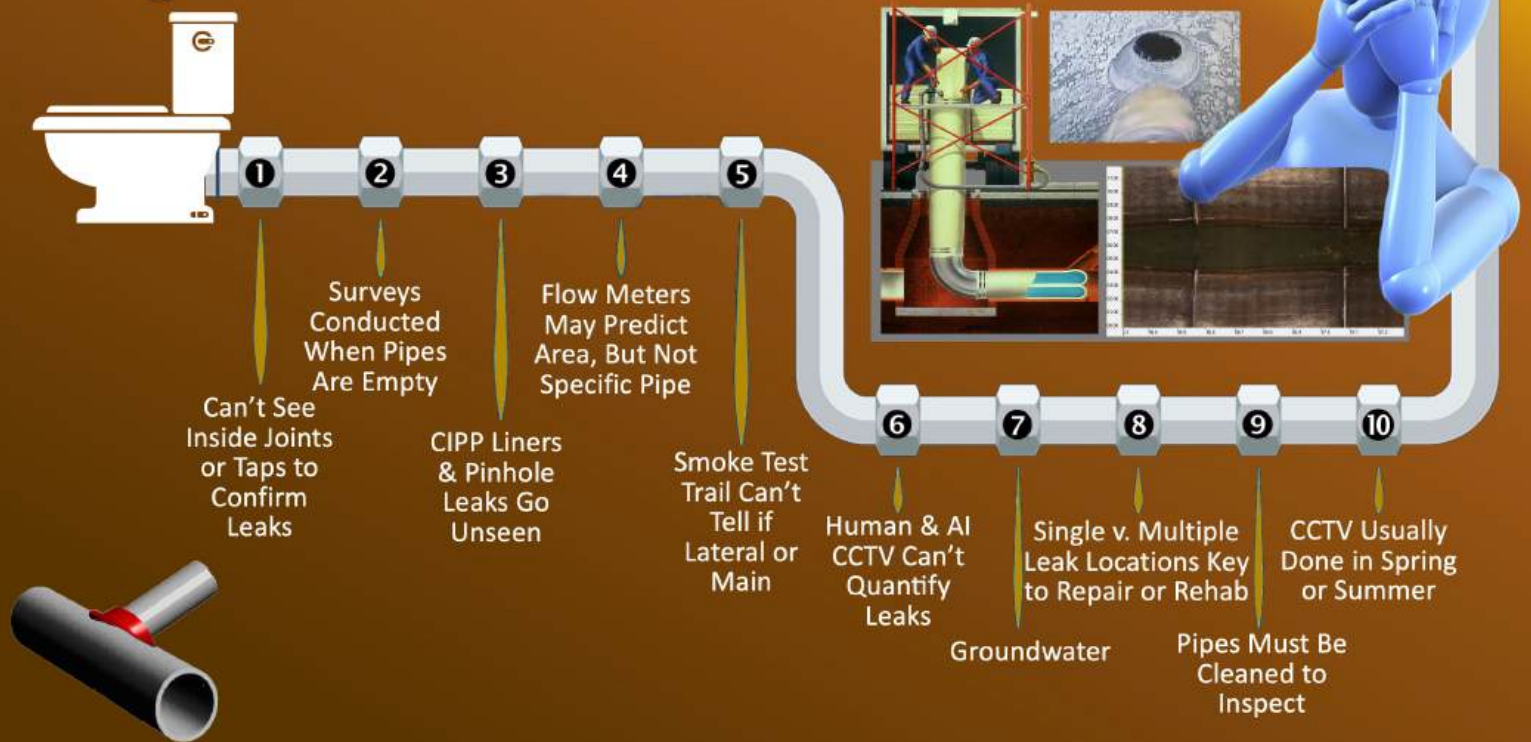


**CCTV Can't
Look Inside Joint
or Turn 90-Degrees**

**CCTV Can't See Inside
But FELL Can!**



Why CCTV Can't Assess Defects?



Random Selection of Pipes Found Similar to Using 1-5 Rating Rating Systems by WRC & NASSCO





100%

Full Pipe Assessment

Camera Can Only See Inside Curved Surface Area

-50%

Inner Pipe Ring

-10%

Inability to 'Assess' Inside Joints

-10%

Inability to 'Assess' Customer Taps or Junctions

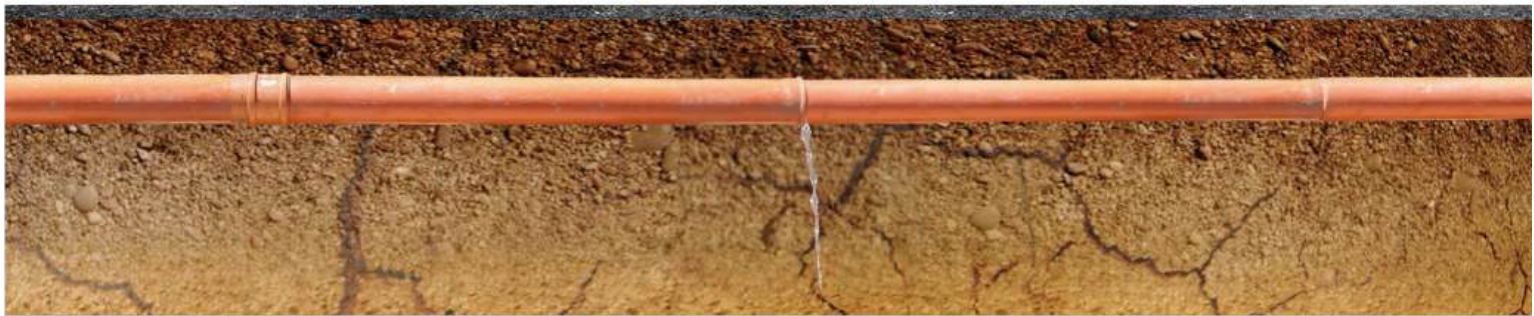
-10%

Actual CCTV Pipe Assessment

20%

8 CURRENT WRC & NASSCO STANDARDS MAKE NO ATTEMPT TO Identify or Measure Leaks

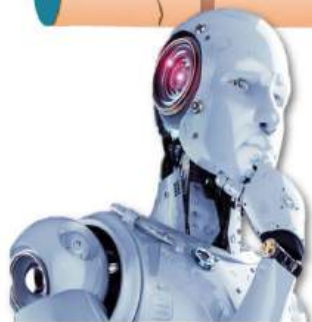
C CRACK 3-4 C1 Longitudinal 5-2 C2 Circumferential 5-2 C3 Multiple 5-2 C4 Spiral 5-2	F FRACTURE 5-7 F1 Longitudinal 5-7 F2 Circumferential 5-7 F3 Multiple 5-7 F4 Spiral 5-7	R BROKEN 5-14 R1 Joint Visible 5-14 R2 Beyond Defect 5-14 R3 V-Notch Visible 5-14 R4 Beyond Defect 5-14	H HOLE 5-16 H1 Joint Visible 5-16 H2 Beyond Defect 5-16 H3 V-Notch Visible 5-16 H4 Beyond Defect 5-16	D DEFORMED 5-18 D1 Deformed 5-18 D2 Vertically Deformed 5-18 D3 Deformed Horizontally (Heave) 5-18	X COLLAPSE 5-22 X1 Joint Offset 5-22 (Displaced) X2 Joint Separated 5-22 (Offset) X3 Joint Angled 5-22	D DEPOSITS 6-1 D1 Attached 6-1 D2 Encrustation 6-1 D3 Growth 6-1 D4 Scaling 6-1 D5 Other 6-1	D DEPOSITS 6-1 D1 Attached 6-1 D2 Encrustation 6-1 D3 Growth 6-1 D4 Scaling 6-1 D5 Other 6-1	D DEPOSITS 6-1 D1 Attached 6-1 D2 Encrustation 6-1 D3 Growth 6-1 D4 Scaling 6-1 D5 Other 6-1	R ROOTS 6-7 R1 Fine 6-7 R2 Small 6-7 R3 Large 6-7 R4 Obstructive 6-7	R ROOTS 6-7 R1 Fine 6-7 R2 Small 6-7 R3 Large 6-7 R4 Obstructive 6-7	R ROOTS 6-7 R1 Fine 6-7 R2 Small 6-7 R3 Large 6-7 R4 Obstructive 6-7	R ROOTS 6-7 R1 Fine 6-7 R2 Small 6-7 R3 Large 6-7 R4 Obstructive 6-7
S SURFACE DAMAGE 5-30 S1 Roughness 5-30 S2 Increased 5-30 S3 Mechanical 5-30 S4 Chemical Attack 5-30 S5 Red Rust 5-30	S SURFACE DAMAGE 5-30 S1 Roughness 5-30 S2 Increased 5-30 S3 Mechanical 5-30 S4 Chemical Attack 5-30 S5 Red Rust 5-30	S SURFACE DAMAGE 5-30 S1 Roughness 5-30 S2 Increased 5-30 S3 Mechanical 5-30 S4 Chemical Attack 5-30 S5 Red Rust 5-30	S SURFACE DAMAGE 5-30 S1 Roughness 5-30 S2 Increased 5-30 S3 Mechanical 5-30 S4 Chemical Attack 5-30 S5 Red Rust 5-30	S SURFACE DAMAGE 5-30 S1 Roughness 5-30 S2 Increased 5-30 S3 Mechanical 5-30 S4 Chemical Attack 5-30 S5 Red Rust 5-30	S SURFACE DAMAGE 5-30 S1 Roughness 5-30 S2 Increased 5-30 S3 Mechanical 5-30 S4 Chemical Attack 5-30 S5 Red Rust 5-30	I INSULATION 6-15 I1 Missing 6-15 I2 Damaged 6-15 I3 Missing 6-15 I4 Missing 6-15	OB OBSTACLES 6-19 OB1 Weeper 6-19 OB2 Branch or Manway 6-19 OB3 Pipe Material in View 6-19	OB OBSTACLES 6-19 OB1 Weeper 6-19 OB2 Branch or Manway 6-19 OB3 Pipe Material in View 6-19	OB OBSTACLES 6-19 OB1 Weeper 6-19 OB2 Branch or Manway 6-19 OB3 Pipe Material in View 6-19	OB OBSTACLES 6-19 OB1 Weeper 6-19 OB2 Branch or Manway 6-19 OB3 Pipe Material in View 6-19	V VERMIN 6-20 V1 Rat 6-20 V2 Cat 6-20 V3 Other 6-20	V VERMIN 6-20 V1 Rat 6-20 V2 Cat 6-20 V3 Other 6-20
S SURFACE DAMAGE 5-30 S1 Roughness 5-30 S2 Increased 5-30 S3 Mechanical 5-30 S4 Chemical Attack 5-30 S5 Red Rust 5-30	S SURFACE DAMAGE 5-30 S1 Roughness 5-30 S2 Increased 5-30 S3 Mechanical 5-30 S4 Chemical Attack 5-30 S5 Red Rust 5-30	S SURFACE DAMAGE 5-30 S1 Roughness 5-30 S2 Increased 5-30 S3 Mechanical 5-30 S4 Chemical Attack 5-30 S5 Red Rust 5-30	S SURFACE DAMAGE 5-30 S1 Roughness 5-30 S2 Increased 5-30 S3 Mechanical 5-30 S4 Chemical Attack 5-30 S5 Red Rust 5-30	LF LINING FAILURE 5-40 LF1 Detached Lining 5-40 LF2 Detached Lining 5-40 LF3 Detached Lining 5-40 LF4 Detached Lining 5-40 LF5 Detached Lining 5-40	LF LINING FAILURE 5-40 LF1 Detached Lining 5-40 LF2 Detached Lining 5-40 LF3 Detached Lining 5-40 LF4 Detached Lining 5-40 LF5 Detached Lining 5-40	WP WELD FAILURE 5-40 WP1 Longitudinal 5-40 WP2 Circumferential 5-40 WP3 Misaligned 5-40 WP4 Spall 5-40 WP5 Unfinished 5-40	RP POINT REPAIR 5-42 RP1 Pipe Replacement 5-42 RP2 Excavate 5-42 RP3 Patch Repair 5-42 RP4 Excavate 5-42	RP POINT REPAIR 5-42 RP1 Pipe Replacement 5-42 RP2 Excavate 5-42 RP3 Patch Repair 5-42 RP4 Excavate 5-42	BRICKWORK 5-48 BR1 Displaced 5-48 BR2 Missing 5-48 BR3 Damaged 5-48	BRICKWORK 5-48 BR1 Displaced 5-48 BR2 Missing 5-48 BR3 Damaged 5-48	BRICKWORK 5-48 BR1 Displaced 5-48 BR2 Missing 5-48 BR3 Damaged 5-48	



7 SUPERFICIAL CRACKS CALLED OUT BY CCTV, CANNOT CONFIRM IF Cracks Go Through Wall

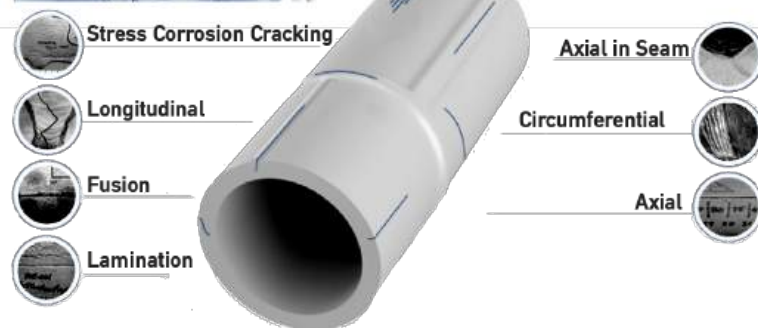


CCTV Cameras Can't Tell if Cracks or Bad Joints Leak Through Pipe Wall Leading to Poor Repair Decisions.



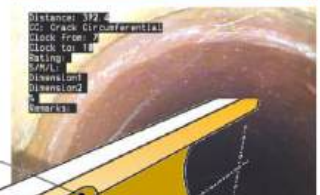
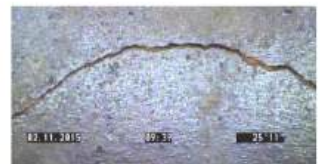
AI CAN'T SEE WHAT CCTV CAN'T SEE!

MISSING PIECE



PIPE CYLINDER

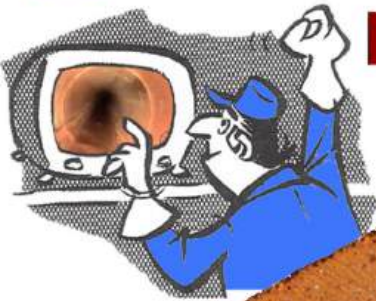
PARTIAL FULL



6 CAMERAS ARE NOT RECOMMENDED TO ACCEPT OR CERTIFY Post-Rehabilitation

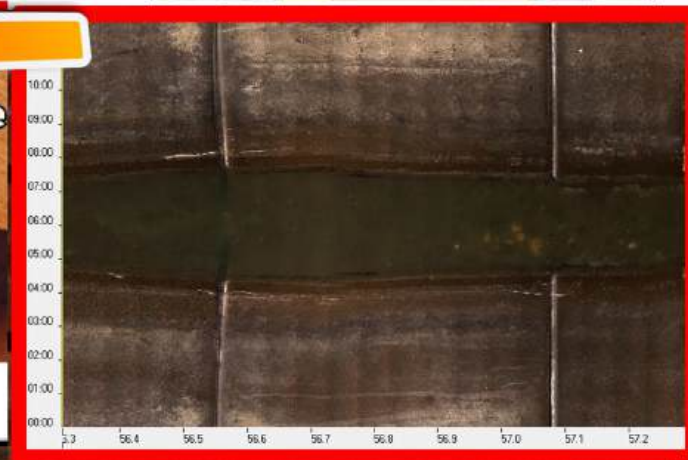


5 CCTV, VISUAL, OR AI INSPECTIONS CANNOT TELL WHETHER Joints Are Watertight?

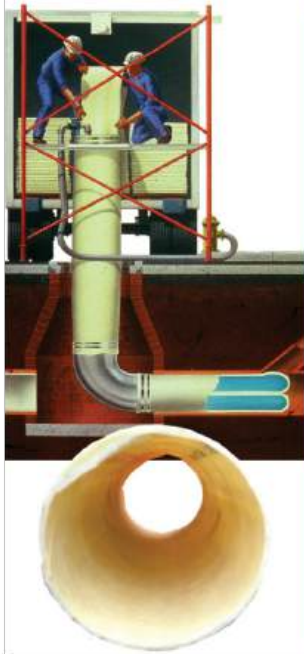


CCTV Can't
Look Inside Joint
or Turn 90-Degrees

CCTV Can't See Inside
But FELL Can!

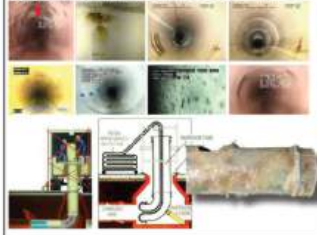


4 CCTV, VISUAL, OR AI INSPECTIONS CANNOT TELL WATER TIGHTNESS OF CURED-IN-PLACE PIPE LINER



CIPP By Curing Method

1. THERMAL-CURED CIPP



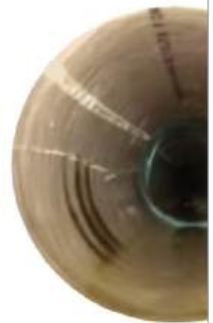
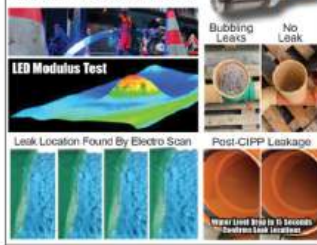
2. STEAM-CURED CIPP



3. UV-CURED CIPP



4. LED-CURED CIPP



3 CCTV CANNOT BE USED TO ASSESS THE INSIDE OF SEWER MAINS WHEN PIPES ARE Full of Water or Surcharged



2 FALSE-POSITIVE CCTV MAY INADVERTANTLY APPROVE Leaks in Plastic Pipe



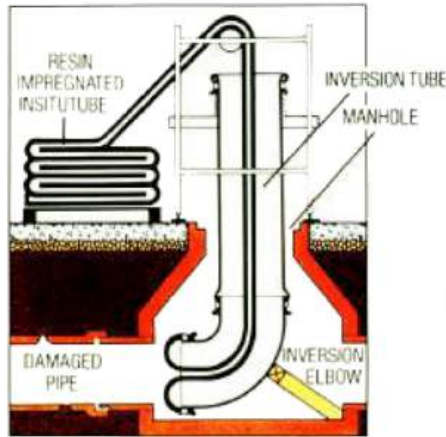
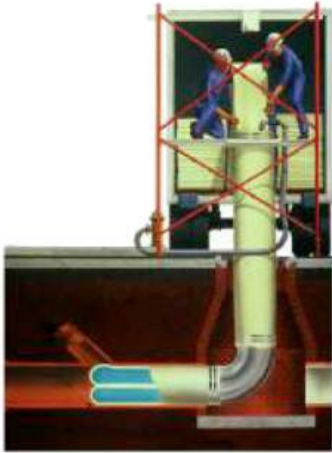
1 NOT POSSIBLE FOR CCTV OR AI TO TELL WHETHER Laterals Are Watertight?



7

Myths

Common Misconceptions of Cured-In-Place Pipe (CIPP)



1. Pinholes are 'Self Healing.'

2. Wrinkles Don't Leak.

3. All CIPP Lasts 50 Years or More.

4. Pipes Will Never Leak More After CIPP Lining.

5. CCTV Inspection is the 'Best Way' to Approve CIPP Liners as 'Leak-Free.'

6. Leaks at Service Connections Are Not Common.

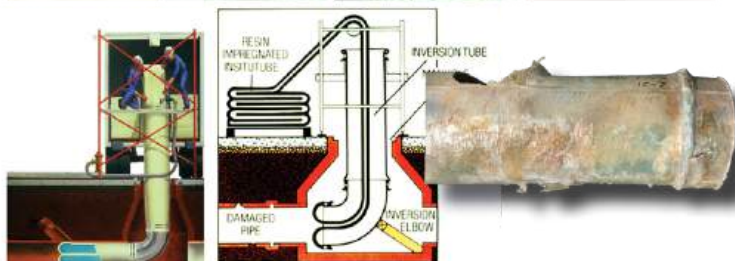
7. CIPP Eliminates 100% of Infiltration

If CIPP Leaks
Electricity,
It Leaks
Water, too.

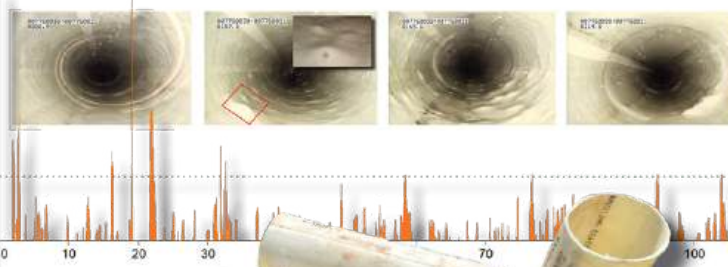
- Chuck Hansen



1. THERMAL-CURED CIPP Boiling Water



2. STEAM-CURED CIPP



Defective CIPP



3. UV-CURED CIPP



**Missed By Acoustic Sensors & CCTV Cameras.
Leaks Found & Measured by Electro Scan.**

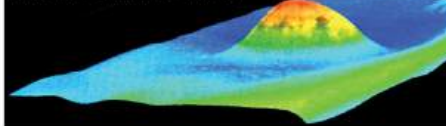


UV-Cured Fiberglass CIPP

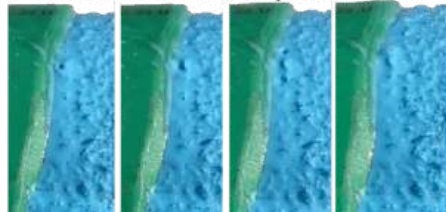
4. LED-CURED CIPP



LED Modulus Test



Leak Location Found By Electro Scan

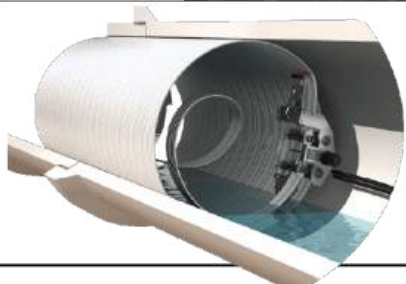
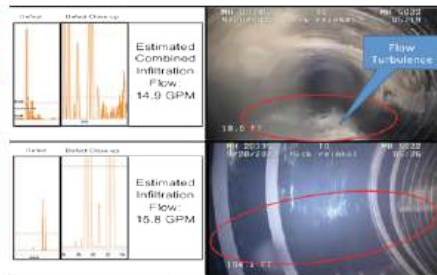
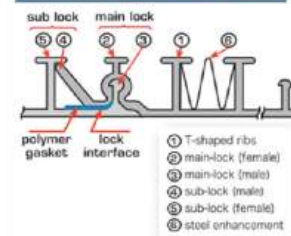
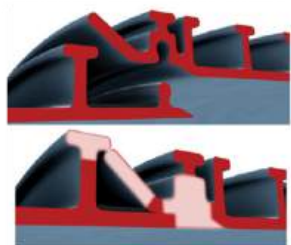


Post-CIPP Leakage



**Water Level Drop in 15 Seconds
Confirms Leak Locations**

5. SPIRAL WOUND PIPE



6. SPRAY-IN-PLACE PIPE



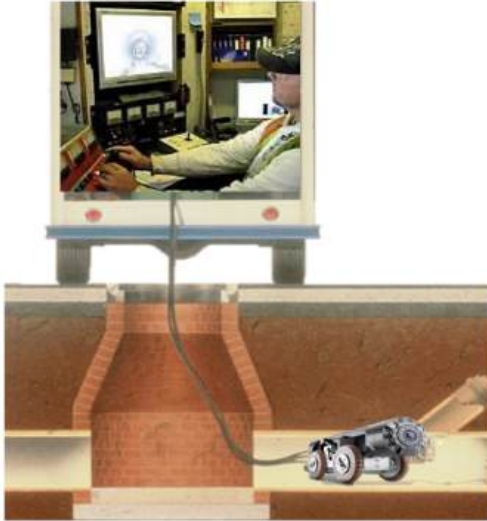
Are TV Cameras Obsolete?



Answer: Not yet, but severely limited.

RECOMMENDED USES FOR CCTV

- Verification of Cleaning
- Location & Position of Customer Laterals
- Fats, Oils, and Grease Removal
- Root Identification & Verification of Removal
- Crossbore Identification
- Debris Removal from New Construction
- Debris Removal from Post-Rehabilitation
- Debris Removal from Protruding Lateral Cutting
- Location of Pipe Collapse Locations (FROM & TO)



No Longer 'Best' for Rehabilitation Decision Support



NOT RECOMMENDED FOR CCTV

- Sewer Survey Evaluation Studies (SSES)
- Inflow & Infiltration Reduction Programs
- Leakage Studies
- Customer Lateral Leak Assessments
- Post-Flood Assessments
- Rehabilitation Selection
- Approval of CIPP for Watertightness
- Siphon & Rising Main Assessments, Without Bypass Pumping
- New Pipe Assessment or Acceptance



UNFORTUNATE FINDINGS

CCTV $\neq$ WATERTIGHT!

**Role of Visual Inspection Reduced.
CCTV Found to Routinely Miss Leaks in Pipes.**



Why Utilities Shift Away From CCTV* To Assess Underground Pipes?

1. CCTV Cameras Only Visually 'See' 20% of the Pipe.
2. CCTV Can't See Leaks Which Are Leading Cause of Sinkholes.
3. CCTV Can't Quantify Leaks in Industry Standard Gallons per Minute.
4. Other Technologies More Accurate, Better for Repair Selection.
5. CCTV Can't Tell Whether Cracks Go Through a Pipe Wall.
6. CCTV Can't Tell Whether Joints Are Watertight.
7. CCTV Can't Verify Trenchless Repairs or Relined Pipes Are Watertight.
8. CCTV Not Able to Measure Pipe Wall Thickness or Corrosion.
9. CCTV Can't Tell If Connections Are Watertight, Before or After Repair.
10. High Costs Incurred to Bypass Pump Pipe Before Able to CCTV.

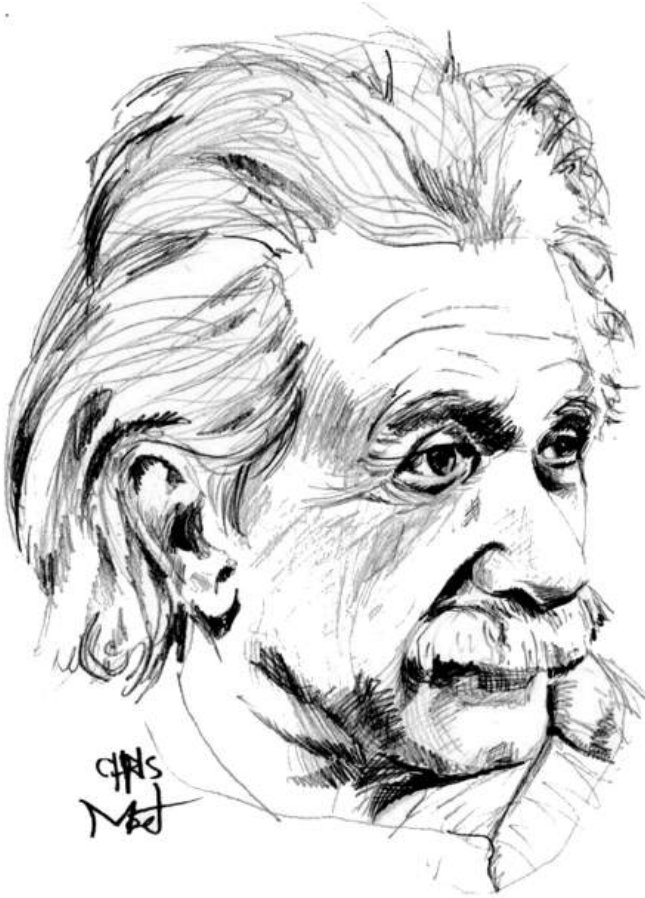
*** AI-CCTV unable to overcome weaknesses of visual inspection.**

**Solved
By AI?**

NO
NO
NO
NO
NO
NO
NO
NO
NO
NO



CCTV or FELL?



“The definition of insanity is doing **the same thing over & over** and expecting different results.”

Albert Einstein

**The Time to Accurately Assess
Sewer & Water Pipes & Provide
Reliable Quality Control of Repairs
Has Arrived.**

CONTACTS



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Since August 2014

WATER

DELTA



TRIDENT



SWORDFISH



SEWER

ES-38



ES-400



ES-620



International Patents

AU 2015238903, AU 2017329037, CA 2864503, CA 2874808, CA 2905492, EP 2748576, EP 3516359, EP 13275131.4, JP 6062541, JP 6193893, JP 6514284, NZ 713053, US 9143740, US 9304055, US 9933329, US 10451515, US 10557772, US 10816431.

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