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NCPI

NATIONAL CLAY PIPE INSTITUTE

A Century Of Leadership

UCT UNDERGROUND CONSTRUCTION TECHNOLOGY

The Underground Utilities Event | July 13-15, 2021 | Music City Center | Nashville, TN

CONTROLLING SSO'S THROUGH AGGRESSIVE CLEANING TECHNIQUES

Kent Carlson
Vice President
National Clay Pipe Institute

PRESENTATION OUTLINE

1. COST OF A SANITARY SEWER OVERFLOW
2. COMMON SEWER CLEANING METHODS
3. HYDRO-JETTING BASICS
    1. JET ANGLES
    2. NOZZLE ORIENTATION
    3. PASSIVE VS. AGGRESSIVE
4. ROTATIONAL NOZZLES
    1. ROOT REMOVAL
    2. GREASE REMOVAL
    3. DEPOSIT REMOVAL
    4. DEFLECTION AND CLEANING
5. HYDRO MECHANICAL TOOLING
6. PIPE MATERIALS VS. CLEANING TOOLS

HOW MUCH DOES A SANITARY SEWER OVERFLOW COST?

WQP WATER QUALITY PRODUCTS MAGAZINE PRODUCTS STOREFRONTS DEALERS COMMERCIAL

AUG 09, 2004

U.S. ANNOUNCES $2 BILLION SEWAGE SPILL AGREEMENT FOR CITY OF LOS ANGELES

Tunneling for installation of the new East Central Interceptor Sewer.
Photo courtesy of the City of Los Angeles

In one of the largest sewage cases in U.S. history, the Department of Justice, U.S. Environmental Protection Agency, the Los Angeles Regional Water Quality Control Board, Santa Monica Baykeeper and a coalition of Los Angeles community groups have reached a $2 billion settlement with the city of Los Angeles over years of sewage spills.

Under the terms of the historic agreement, the city of Los Angeles will rebuild at least 488 miles of sewer lines, clean 2,800 miles of sewers annually, enhance its program to control restaurant grease discharges, increase the sewage system's capacity, and plan for future expansion.

With approximately 6,500 miles of sewer lines serving almost 4 million residents, the city operates the largest sewage collection system in the country. Since 1994, the city has experienced over 4,500 sewage spills.

COLA 6,700 miles of Sanitary Sewers

2001 – **1,200+ spills**

2018 **-73 spills**

COMMON SEWER CLEANING METHODS

HYDRO JETTING

Directs high pressure jets of water via a nozzle against the pipe wall. Removes debris and grease build ups, cuts roots, clears blockages, and flushes the sewer pipe.

BALLING

A grooved rubber ball attached by a cable and pulled down the sewer. A spinning and scrubbing action of the ball is created by the water flowing around the ball and along the pipe wall at a high velocity.

MECHANICAL RODDING

The rodding machine has a motor and clutch that provides continual forward and reverse lateral and or rotational movement of a sewer rod at low speeds and but high torque. Cutting heads that address different types of cleaning applications are attached to the end of the rod and inserted into the sewer.

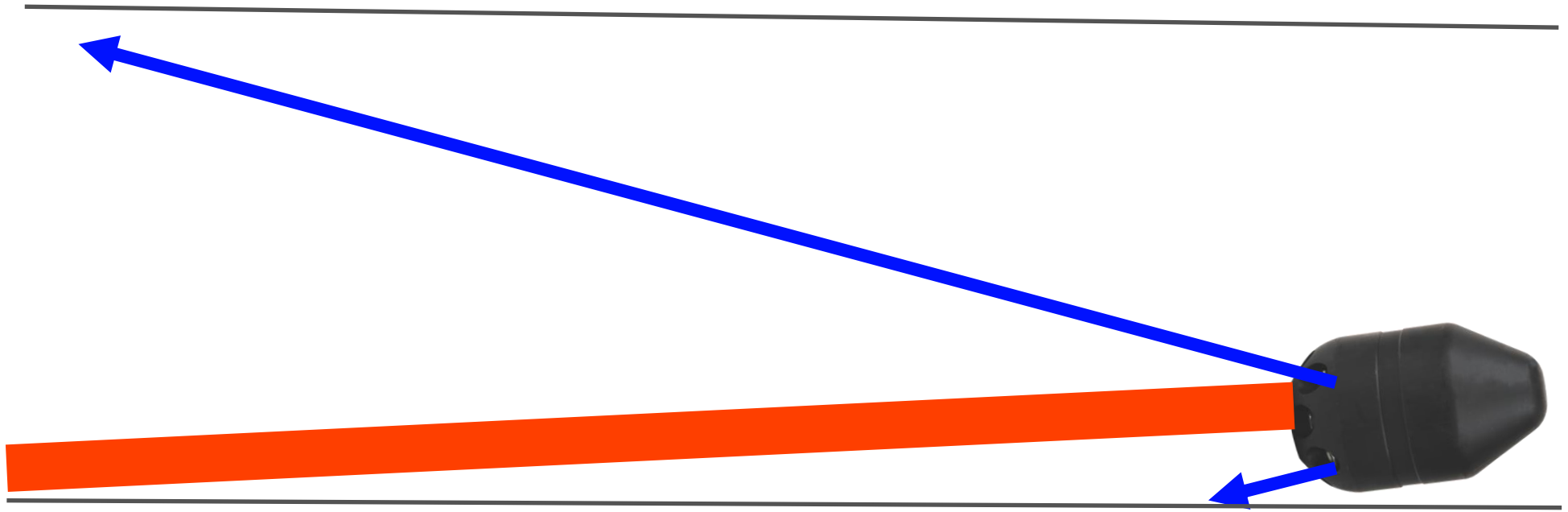
BUCKET MACHINE

A cylindrical device with opposing hinged jaws that is attached by a cable and pulled through the sewer by a winch. The jaws open and scrape the debris from the sewer.

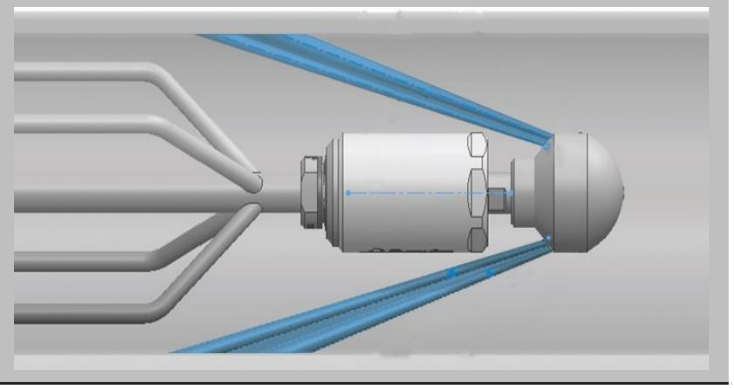
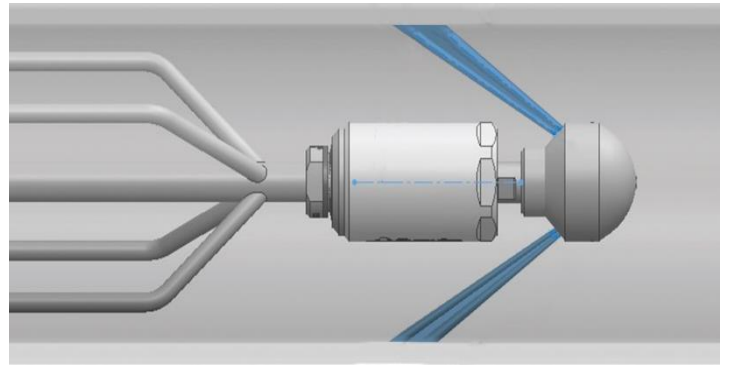
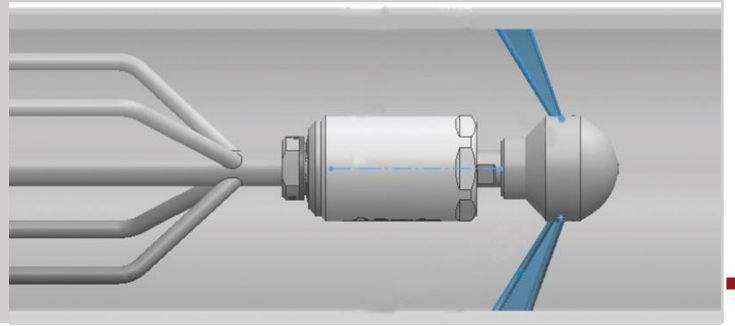
COMBO HYDRO-JET TRUCK

50-80 GPM / 2,000 – 3,000 PSI

The Importance of Jet Angle, Jet Quality, and Nozzle Orientation in Aggressive Cleaning



Jetting Angles Balancing Cleaning & Thrust

Nozzle Jet Angle (degrees)	Thrust Power	Impact Force / Cleaning Effectiveness	Balance of Force & Thrust
6 to 15	Excellent	Insufficient	Lower jetting angles result in high-thrust, but minimal cleaning power. 
16 to 20	Good	Marginally Adequate	
21 to 29	Balanced jetting angles thrust to impact force cleaning ratio		Balanced jetting angles balance the need to clean with the need for thrust to propel 
30 to 35	Adequate water jets have moderate impact force	Adequate	
36 to 45	Marginally Adequate	Good for removing deposits.	Wide-angle jets result in low thrust, but excellent cleaning 
46 to 90	Insufficient	Excellent for removing calcium, roots, calcified grease, etc.	

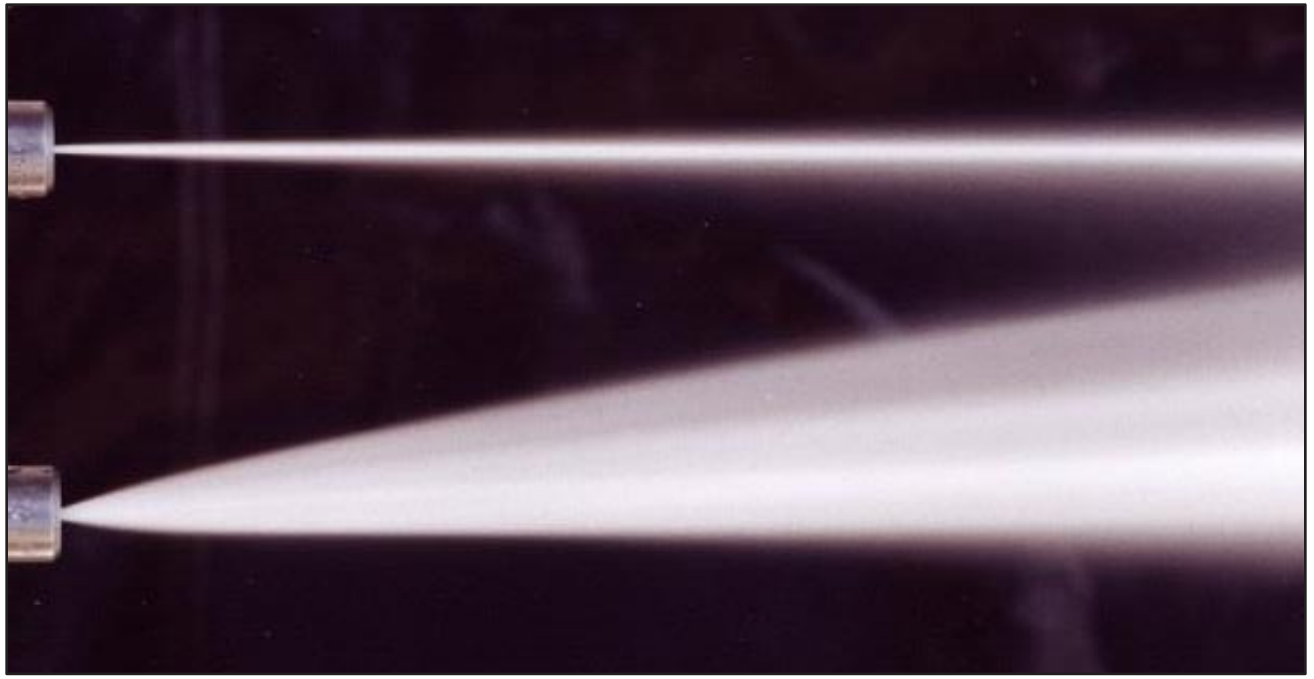
PASSIVE CLEANING OF TURBUCULATION AND DEBRIS FROM DUCTILE IRON PIPE

JET QUALITY

- **High Quality Jets Have a Cohesive Jet Stream.**
  - Cohesive jet streams travel further through the air before breaking into droplets.
  - Cohesive jet streams carry energy for longer.

Coherent Jet Stream

Not a Coherent Jet Stream

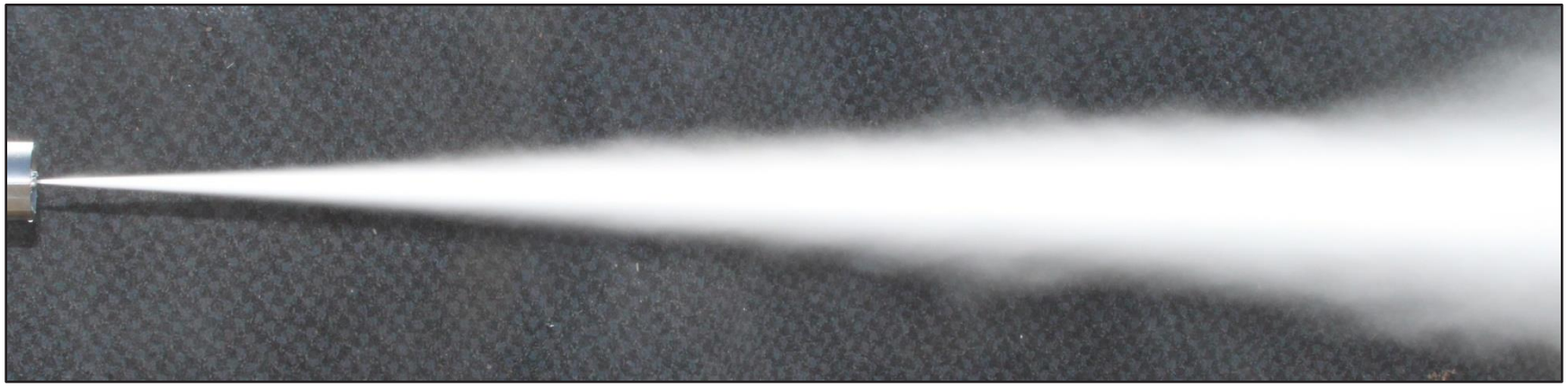


High Jet Quality

Low Jet Quality

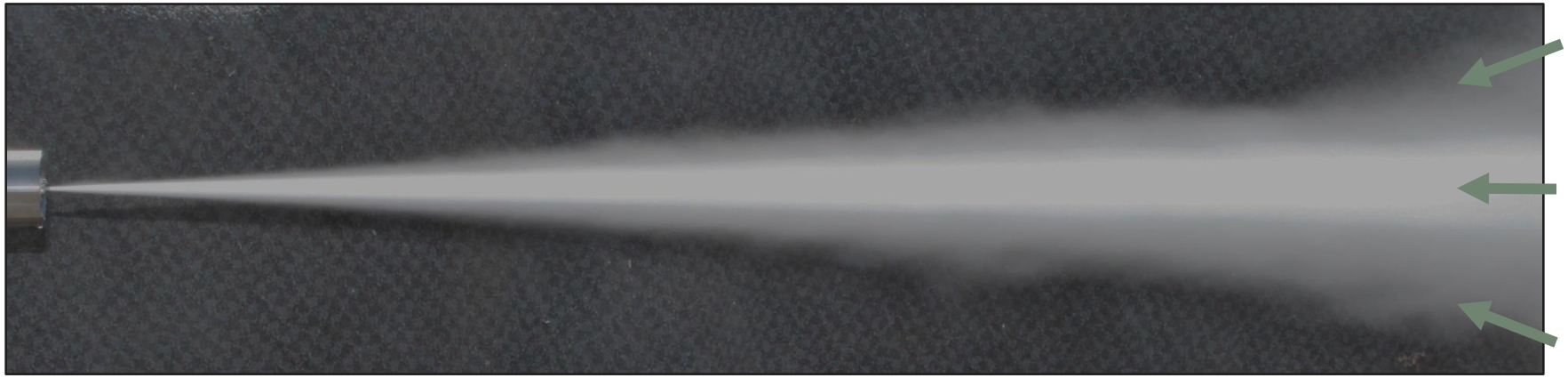
JET QUALITY

- **As a Water Jet Moves Through the Air, it Deteriorates.**



Good quality jet stream

Photo Filtering Shows Jet Core



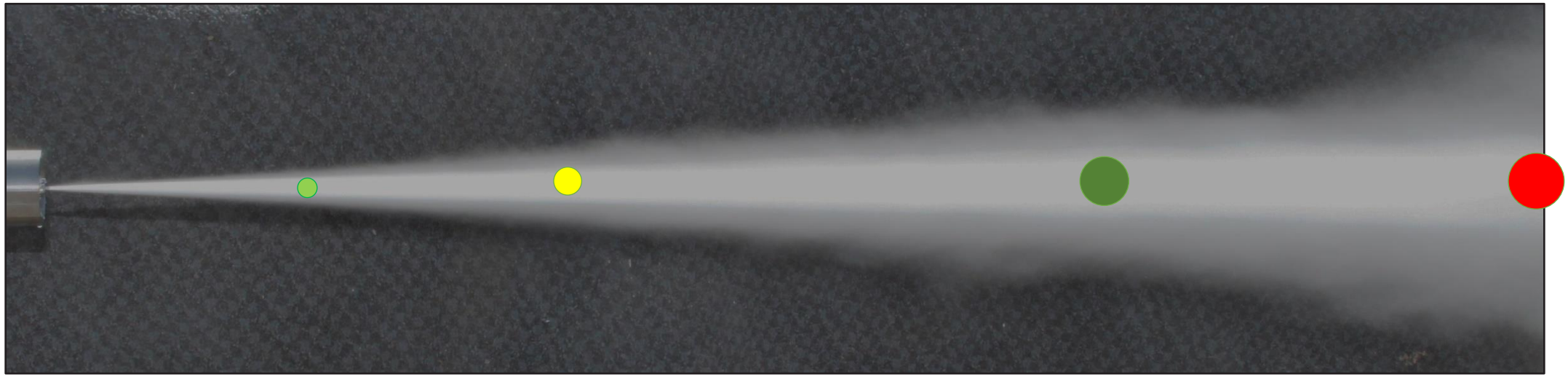
Mist cloud surrounding jet core

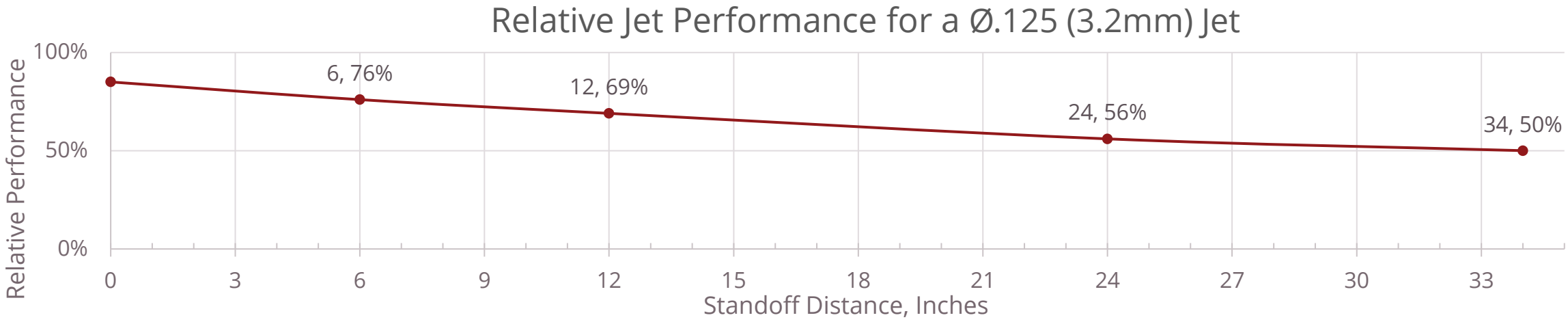
Core peels away & forms mist

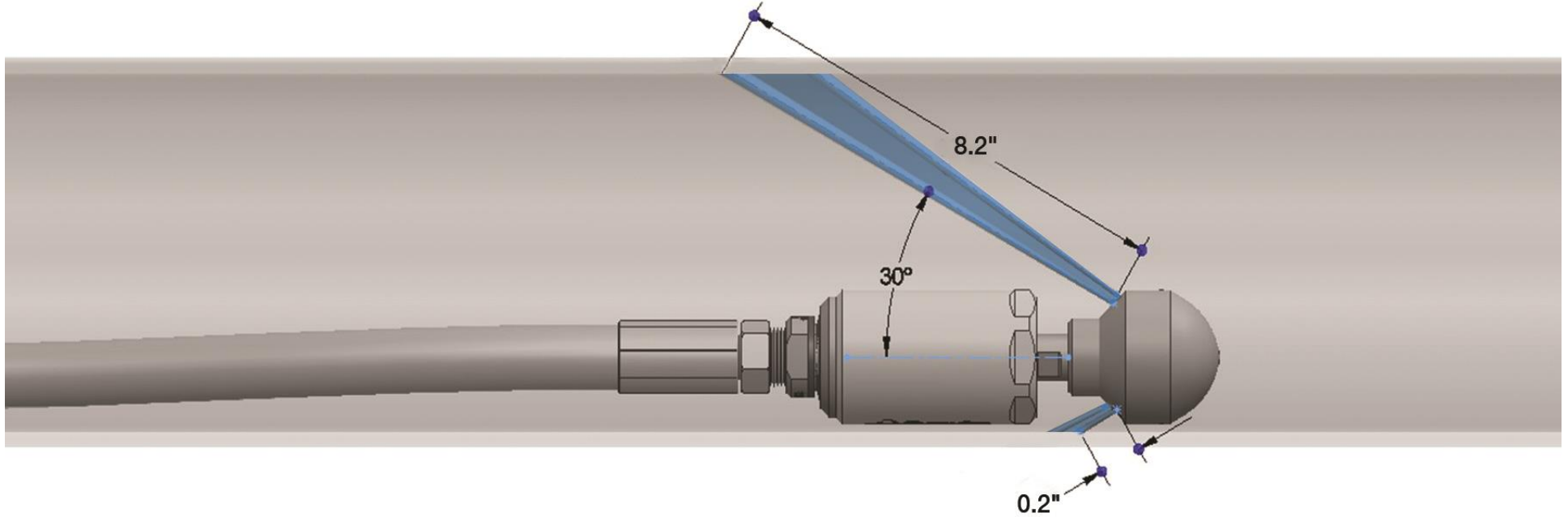
Mist cloud surrounding jet core

JET LOSS OF PERFORMANCE BY DISTANCE TRAVELED

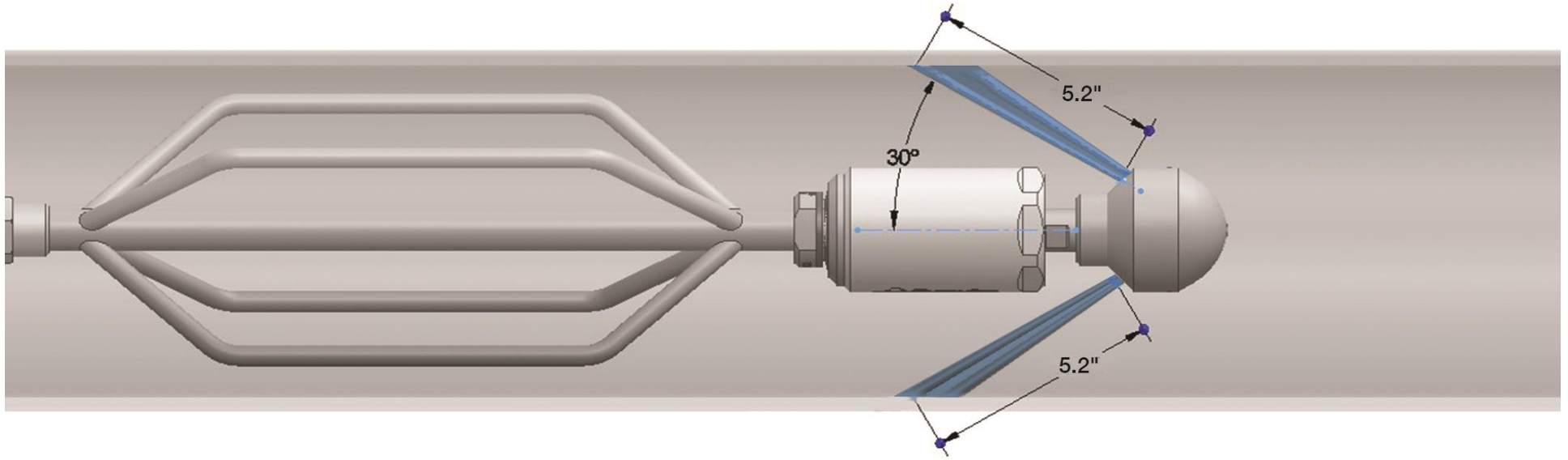
- **Performance Change over the Length of a Ø.125 (3.2mm) Jet**





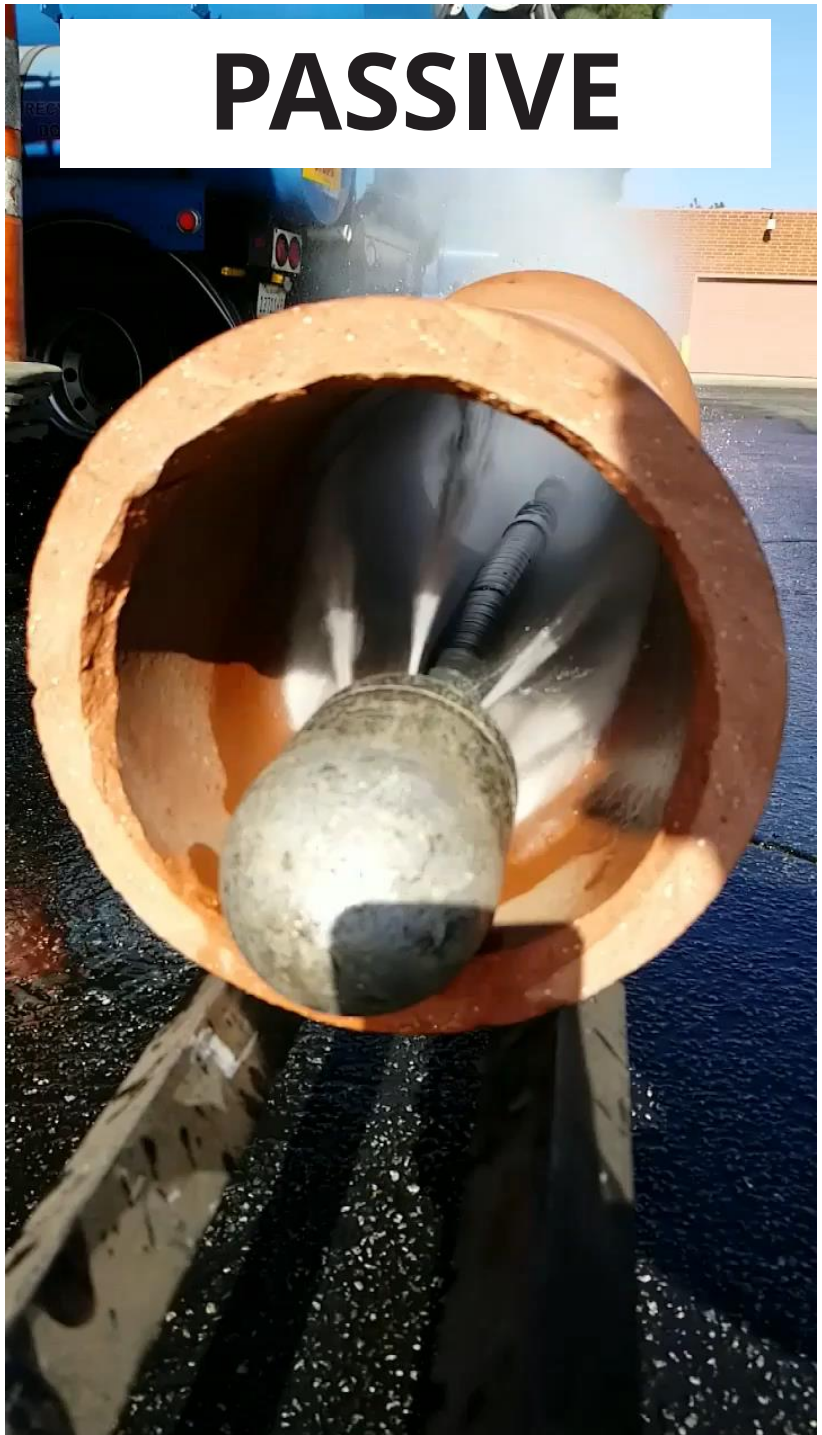


30° REAR FACING JETS, CATFISHING



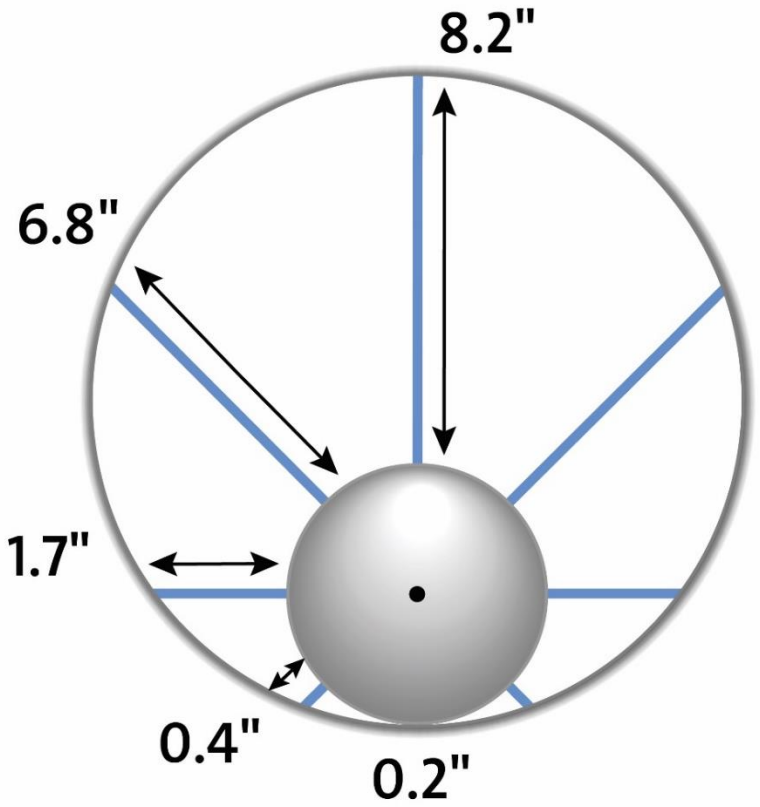
30° REAR FACING JETS, CENTRALIZED

STATIC NOZZLE

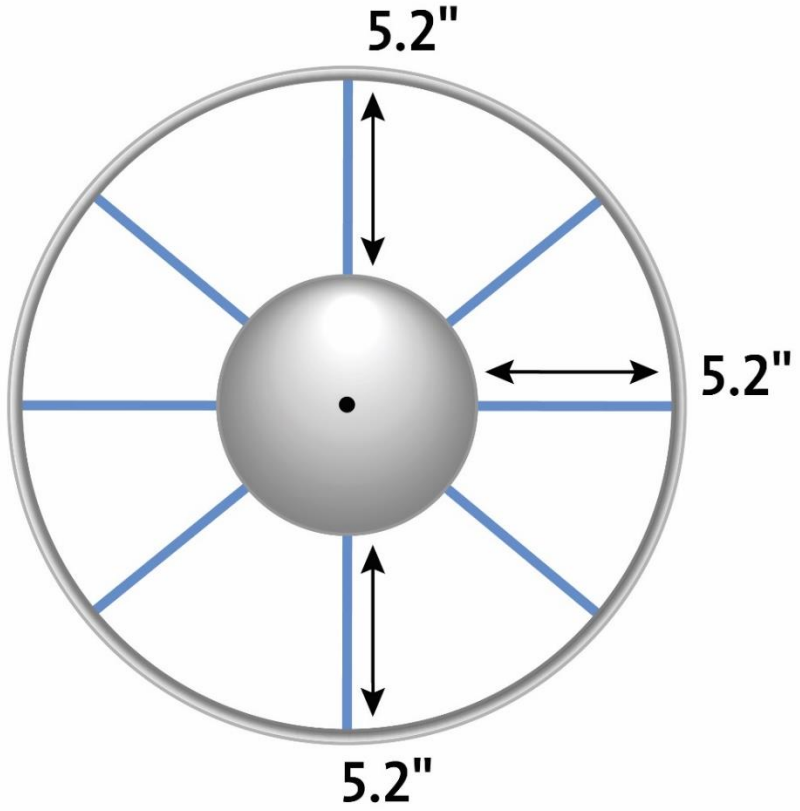


WATER JET STANDOFF DISTANCE COMPARISON*

*All measurements are approximate



CATFISHED NOZZLE
8" PIPE, 30˚JETS



CENTERED NOZZLE
8" PIPE, 30˚JETS

“SPEED SPILLS!”

UNCONTROLLED PASSIVE CLEANING

“Proofing Skid”

- Wired Legged
- Adjustable OD

AGG
STATIC NOZZLE
60 GPM AT
2,000 PSI

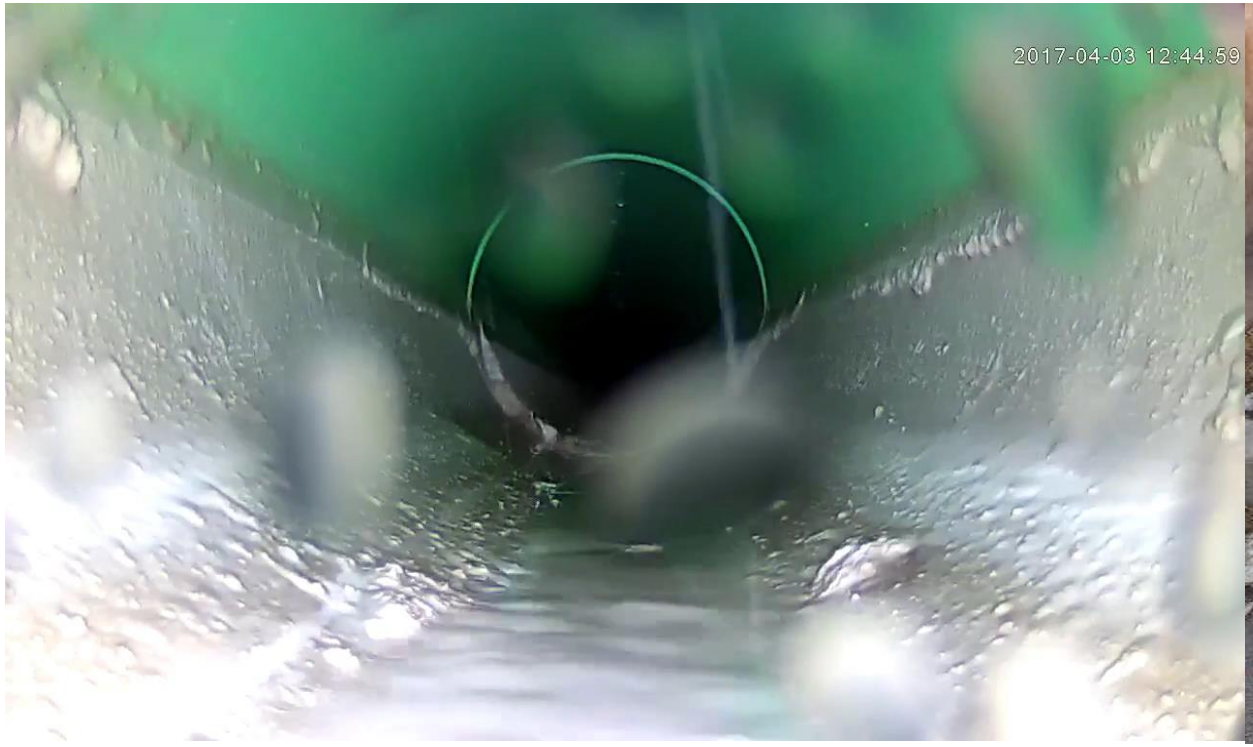
- 4-inch VCP
- 5 minutes

- 4-inch SDR-35 PVC
- 10 seconds

AGGRESSIVE ROTATIONAL NOZZLE

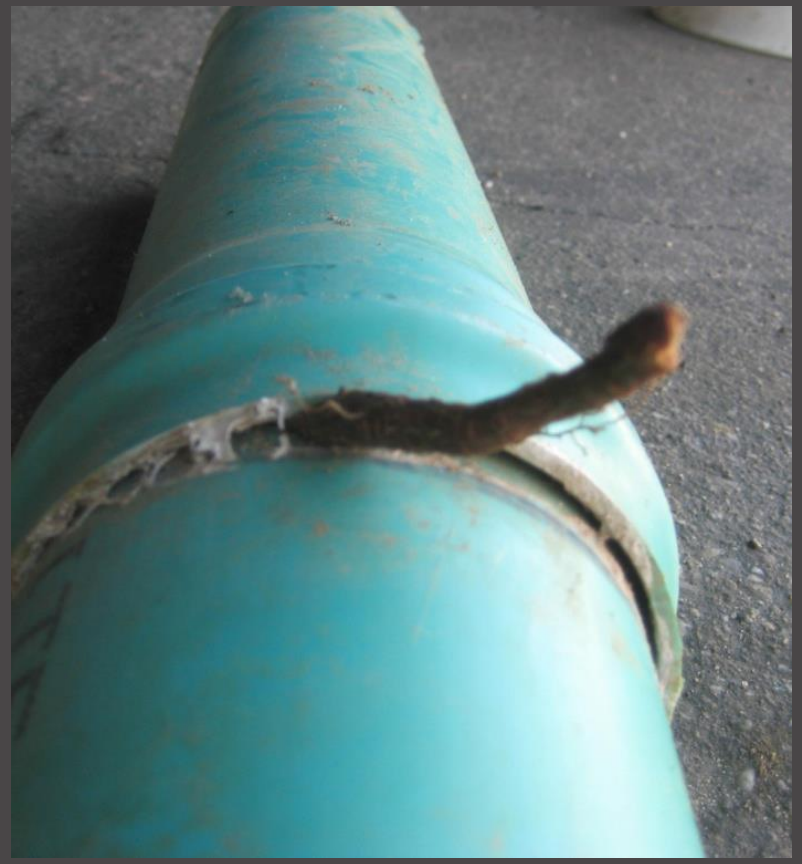
HP WATER JET DAMAGE TO CIPP LINING

CALCIUM AND PLASTER ACCUMULATION



MINERAL DEPOSITS REMOVED FROM VCP

ROOTS AND GREASE



ROOT INTRUSION IN PVC

- **“It is commonly recognized that PVC sewer pipe with gasket joints as commonly installed is not vulnerable to root intrusion.”**
- **Source:** MAINTENANCE OF PVC SEWER PIPE; UNI-TR-3-03 UNI-BELL PVC PIPE ASSOCIATION

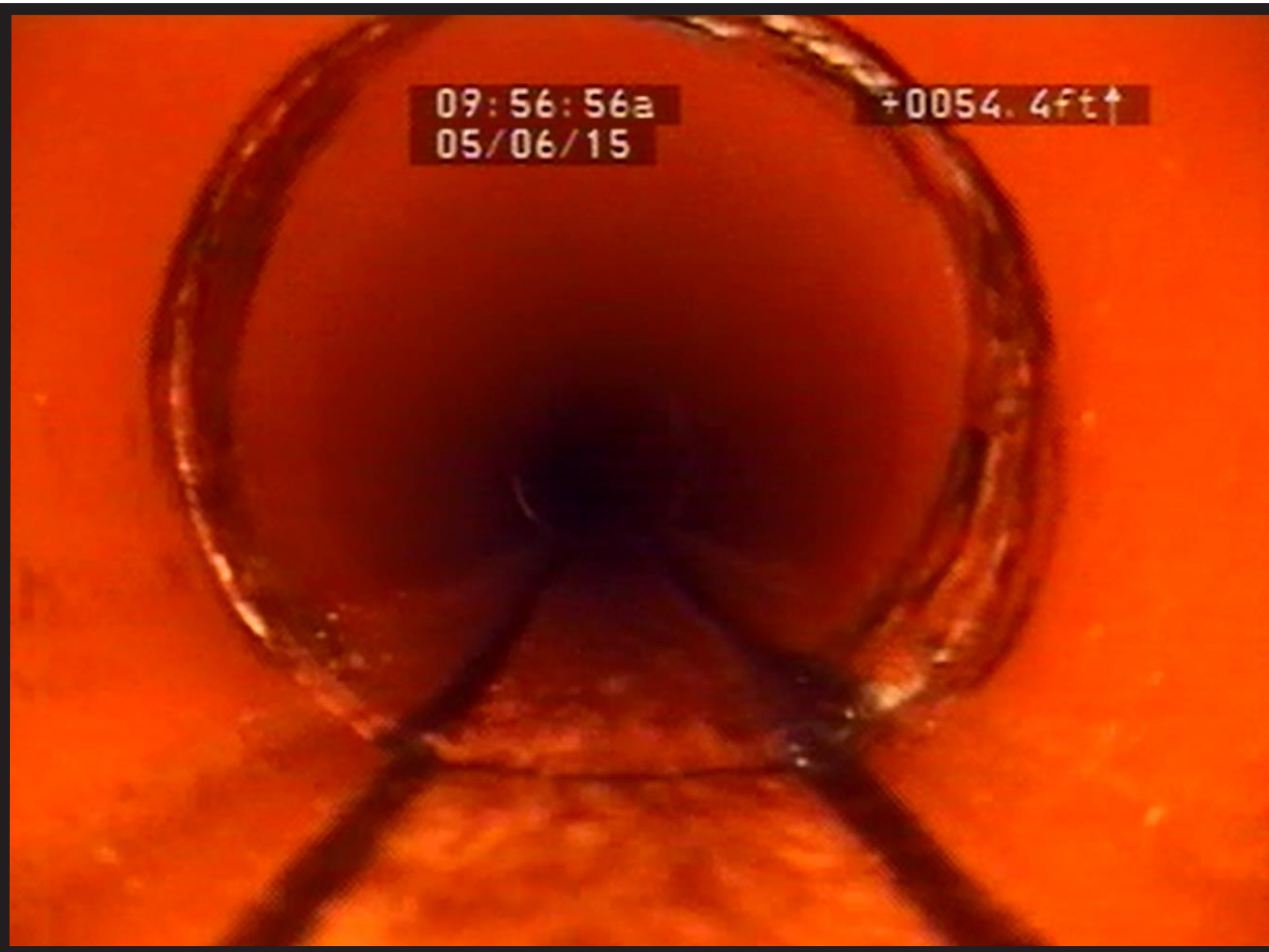
ROTATIONAL NOZZLE –

ROOTS/GREASE

12-inch VCP
Installed 1954
(67 years old)

Field applied
mortar joints

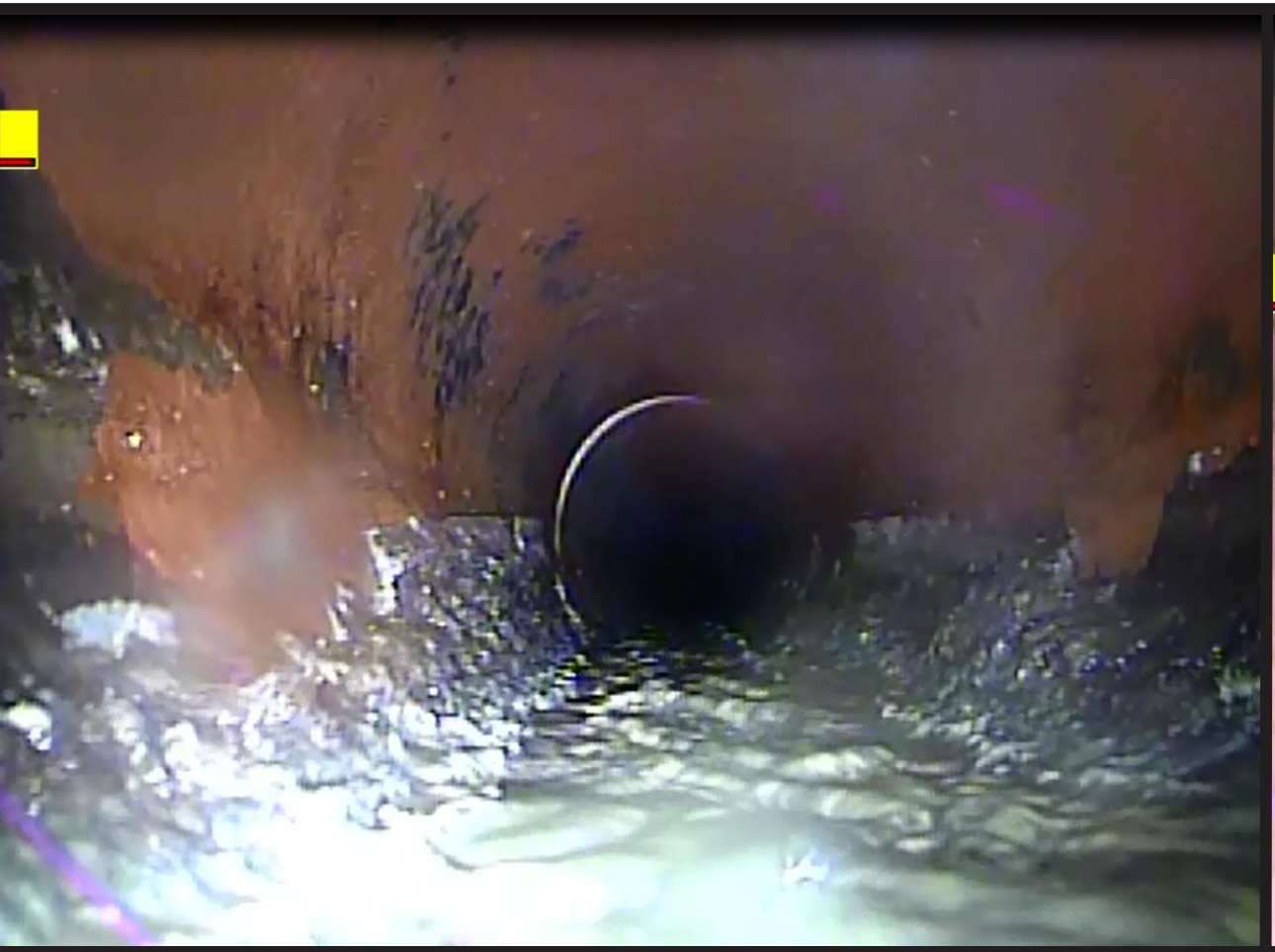
MINERAL DEPOSITS



BEFORE

AFTER

CALCIFIED GREASE



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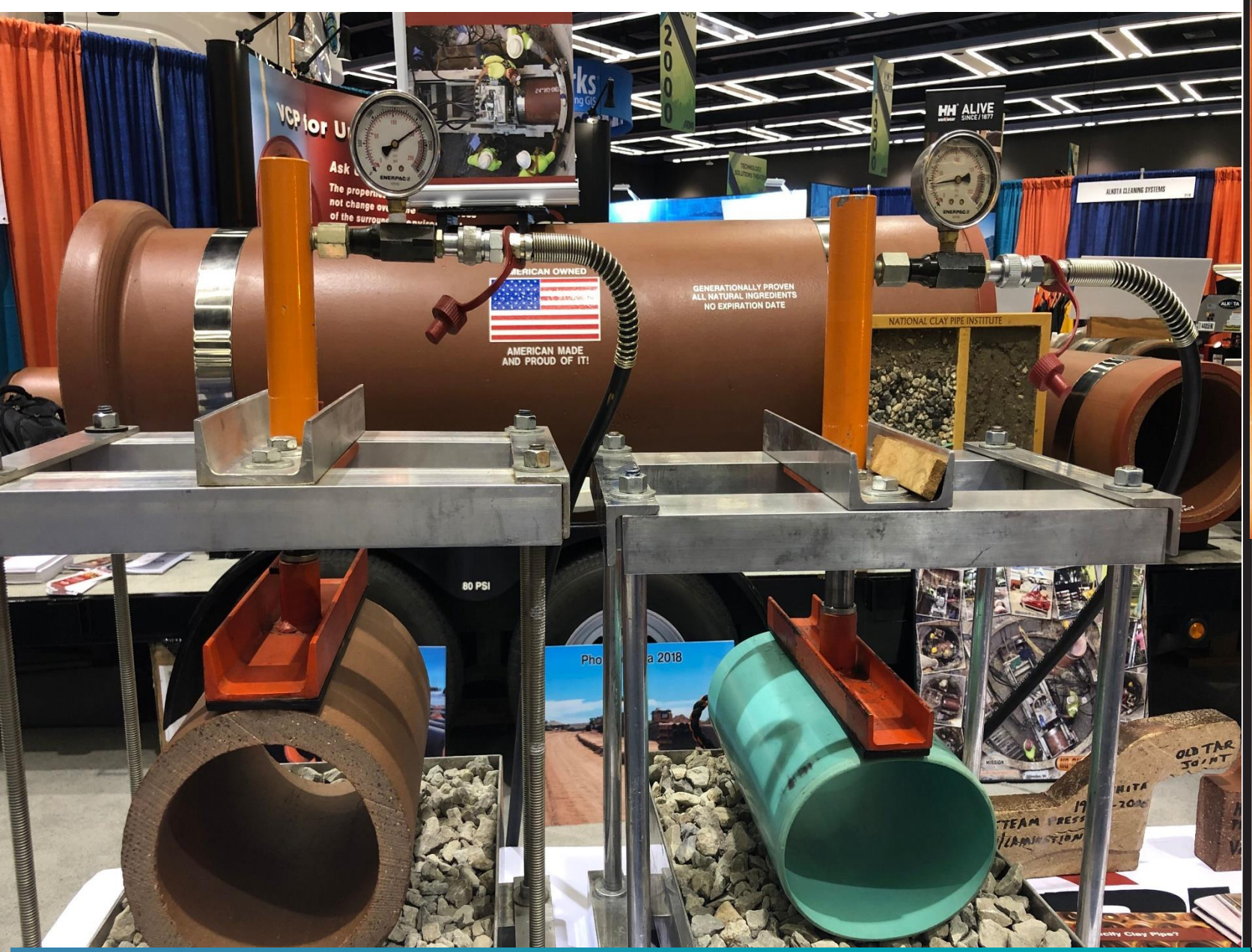

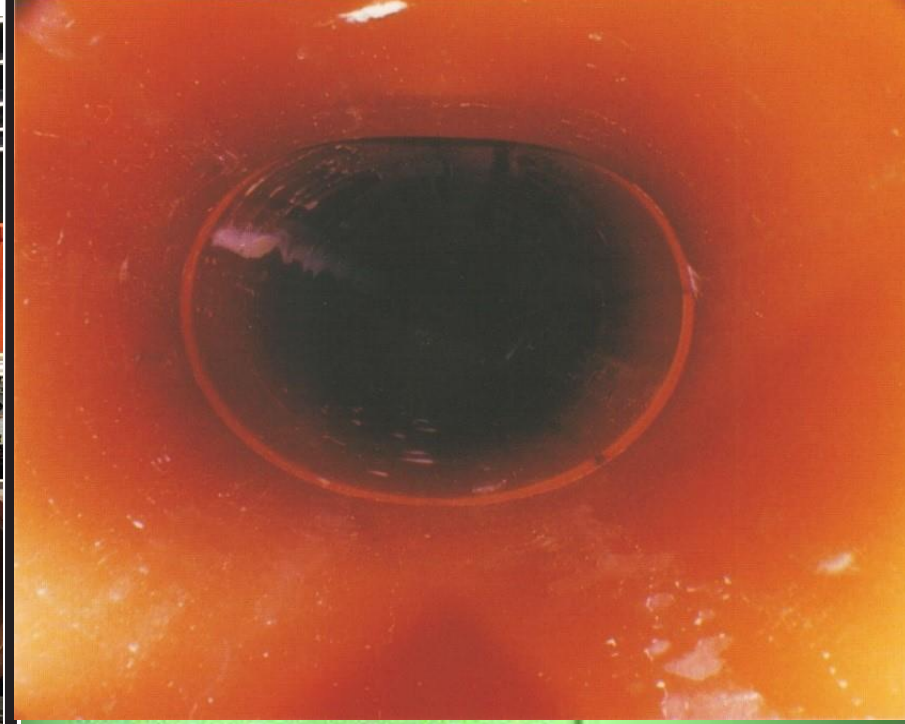

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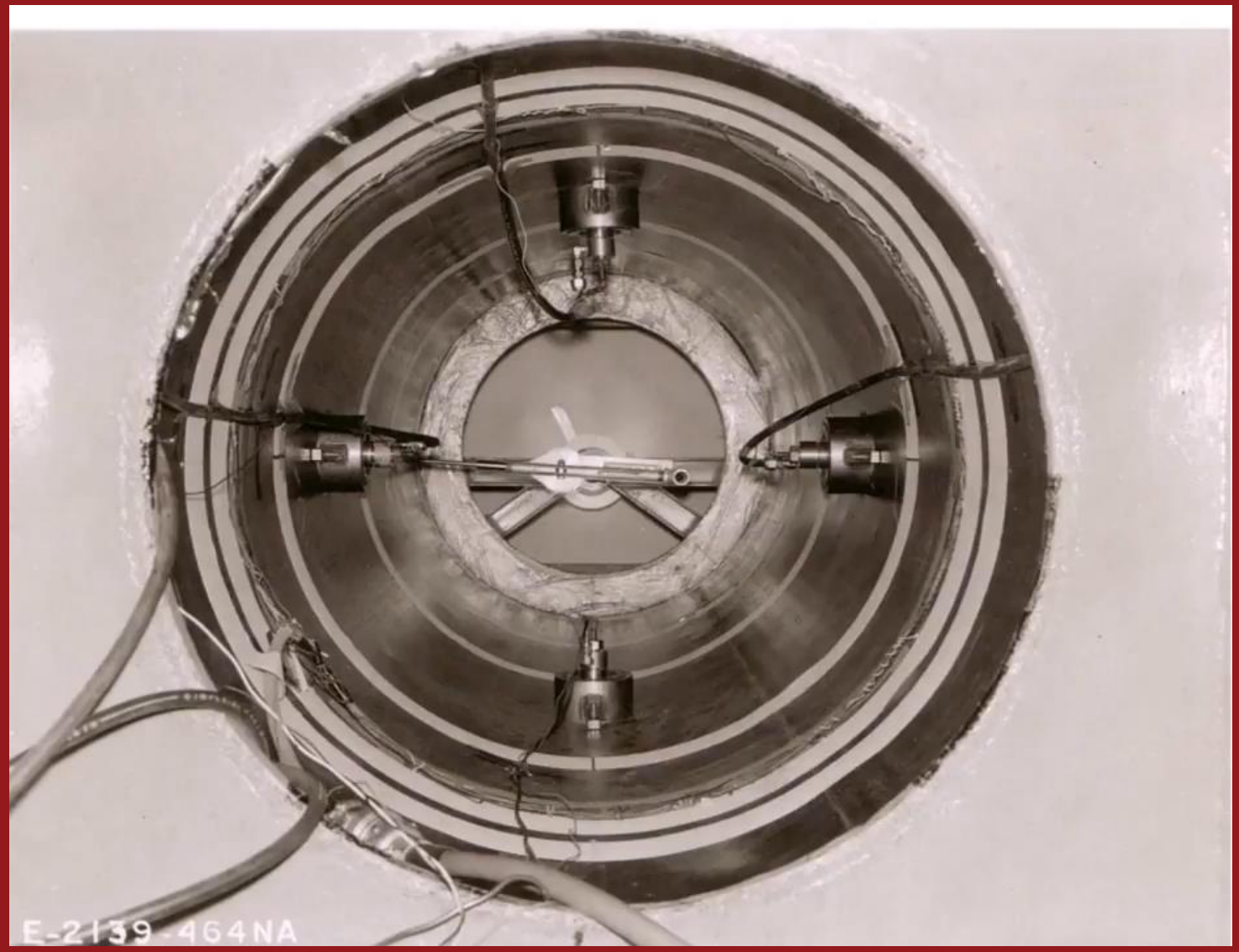
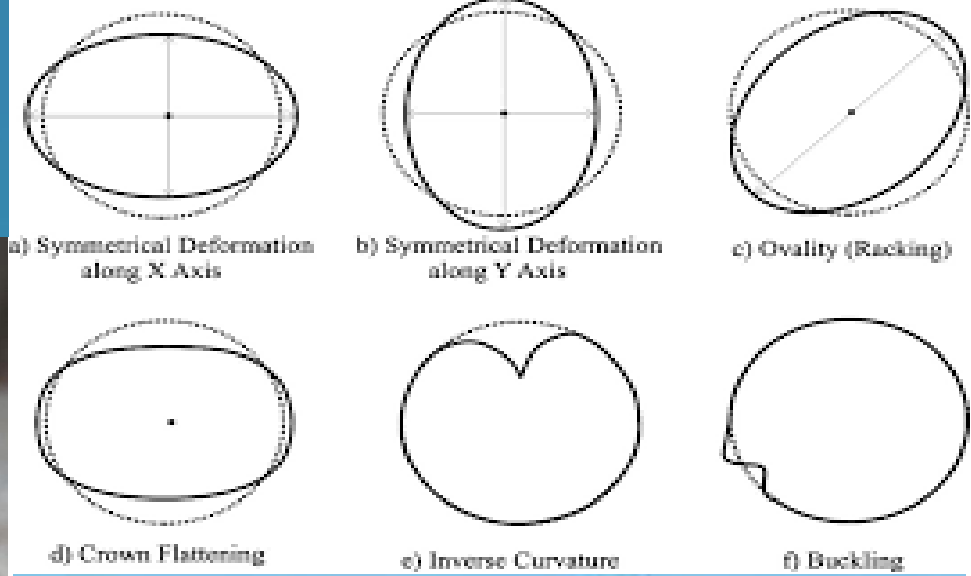
DEFLECTION AND CLEANING

FLEXIBLE PIPE DEFLECTION OVER TIME





“Deflecto-Nozzle”

VERTICAL DEFLECTION

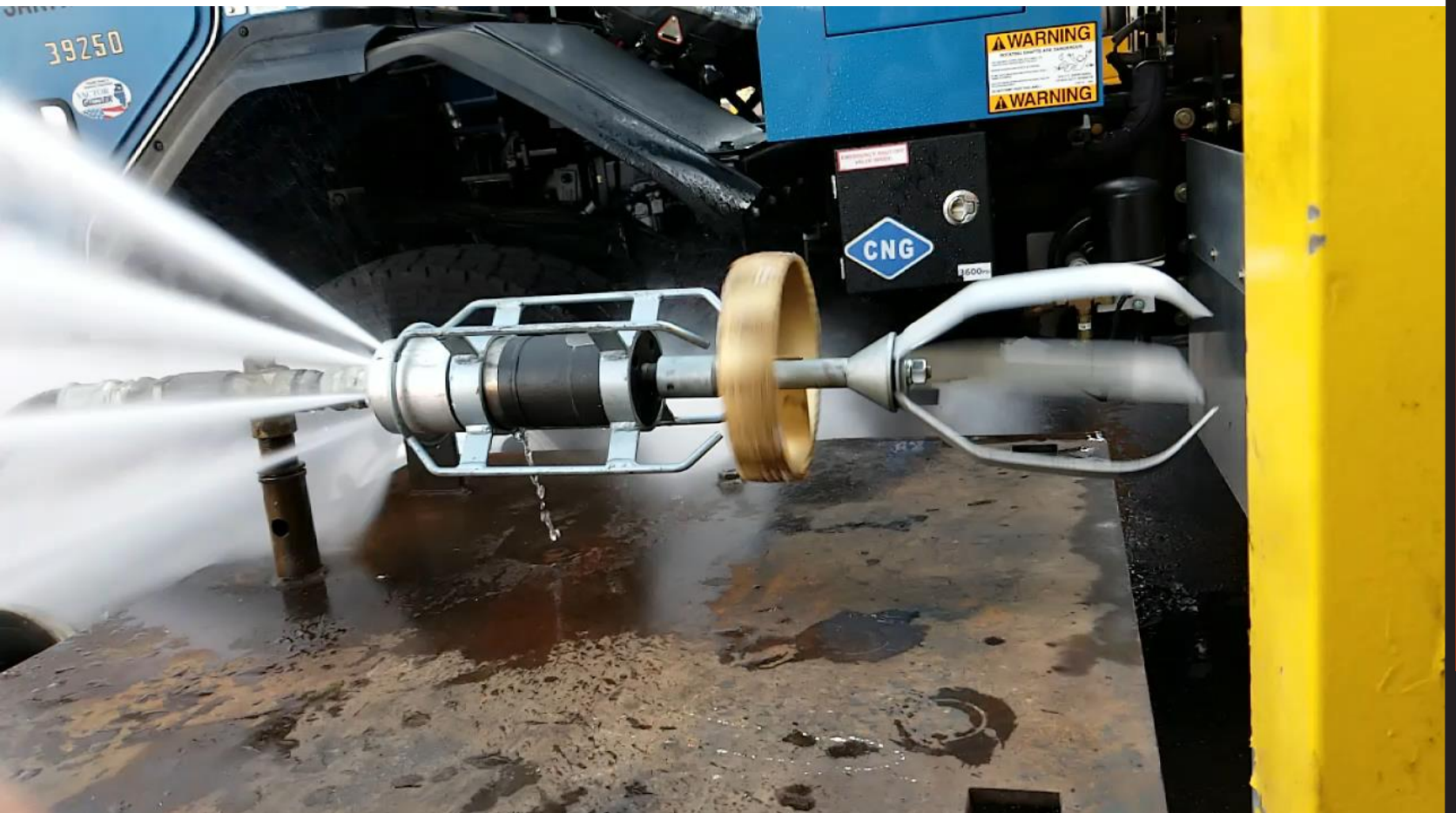
“NOZZLES WITH FLAILING CHAINS,WIRES OR AGGESIVELY ROTATING NOZZLES SHOULD NOT BE USED”

Plastics Industry Pipe Association “Water Jet Cleaning of Plastics Pipe” POP 205

HYDRO – MECHANICAL

CLEANING METHODS

HYDRAULIC ROOT SAW



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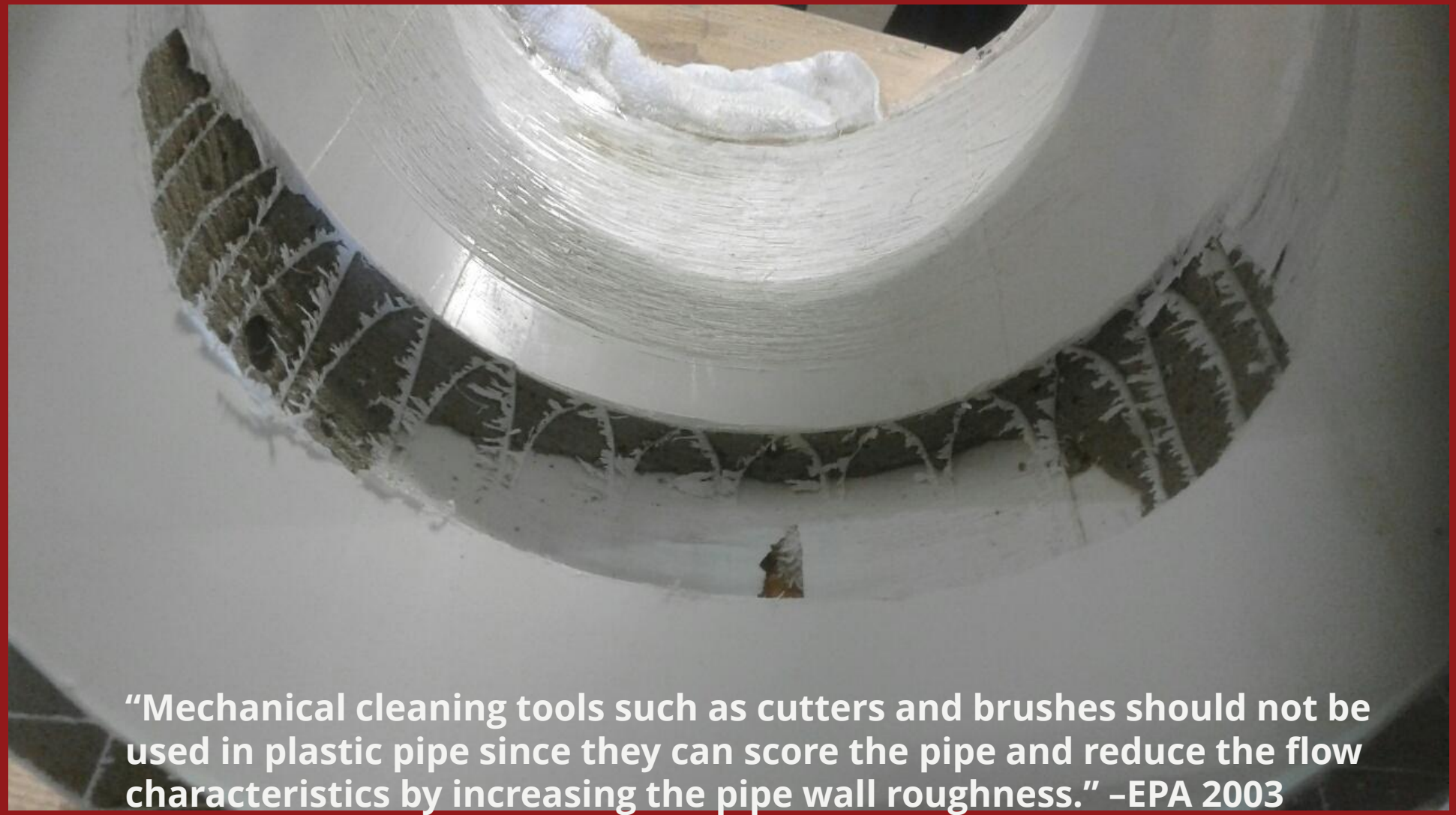


“Mechanical cleaning tools such as cutters and brushes should not be used in plastic pipe since they can score the pipe and reduce the flow characteristics by increasing the pipe wall roughness.” –EPA 2003

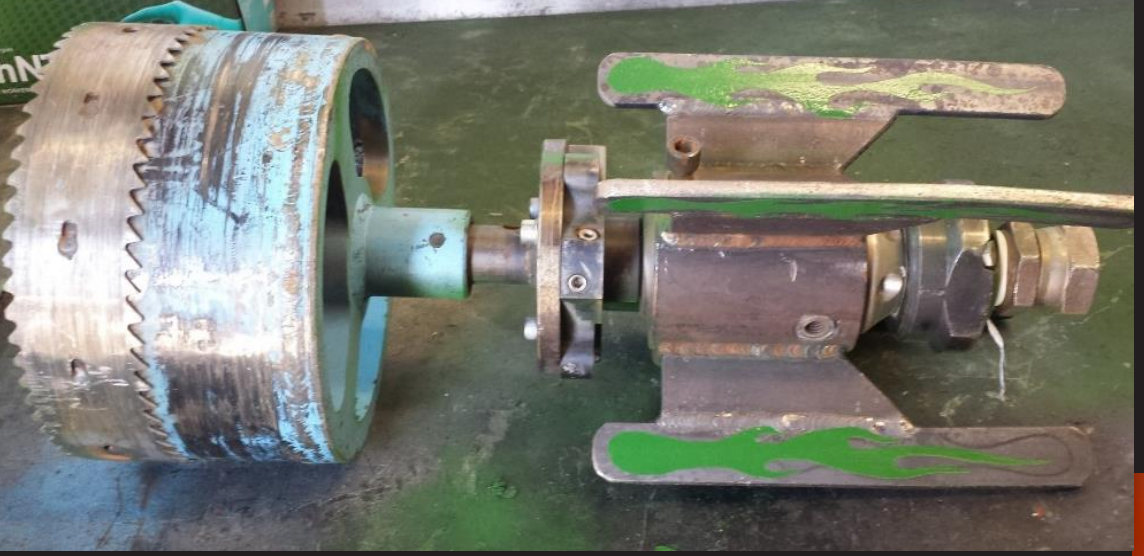
22 INCH VCP PIPE

TOOL: K14 CHAIN CUTTER

CCTV /CLEANING DATE: 2013

PRIOR CLEANING DATE: 1977

36 YEARS BETWEEN CLEANINGS



CAN CUTTER

REMOVAL OF PROTRUDING CIPP LINER

Cleaning Tools In Various Pipe Materials

Cleaning Process	Pipe Material				
	VCP	PVC	HDPE	CIPP	FRP/GRP
Hydro-Jetting	Yes	Yes	Yes	Yes	Yes
- Safe Hydro Pressure (psi)	5,000	1,500[5]	Unknown	1,500[4]	1,200[1,2]
- Jet Angle Range (degrees)	6 - 90	6 - 15[1]	6 - 15[1]	up to 40[4]	6 - 15[1,2]
- Max. Nozzle Weight	125 lbs.	Unknown	Unknown	Unknown	5.5 lbs.[2]
- Min. Jet Standoff from Pipe Wall	¼ in.	1 in.[1]	1 in.[1]	Unknown	Unknown
- Jet Stationary Position	5 min.	60 sec.[1]	60 sec.[1]	Unknown	Unknown
Mechanical Rodders	Yes	No[3,6]	No[3,6]	No[4,6]	No[2,6]
Power Rodders	Yes	No[3,6]	No[3,6]	No[4,6]	No[2,6]
Bucket Machines	Yes	No[3,6]	No[3,6]	No[4,6]	No[2,6]
Brushes	Yes	No[3,6]	No[3,6]	No[4,6]	No[2,6]
Chain Flails	Yes	No[1,3,6]	No[1,3,6]	No[4,6]	No[2,6]
Cable Flails	Yes	No[1,3,6]	No[1,3,6]	No[4,6]	No[2,6]
Grinders	Yes	No[1,3,6]	No[1,3,6]	No[4,6]	No[2,6]
Root Saws	Yes	No[1,3,6]	No[1,3,6]	No[4,6]	No[2,6]
Tap/Can Cutters	Yes	No[1,3,6]	No[1,3,6]	No[4,6]	No[2,6]
Hydraulic Root Saws	Yes	No[1,3,6]	No[1,3,6]	No[4,6]	No[2,6]

[1] Plastics Industry Pipe Association of Australia Limited 2009, Water Jet Cleaning of Plastics Pipes, https://www.iplex.com.au/assets/Uploads/ec9c641256/POP205.pdf

[2] Iplex Pipelines Australia Pty Limited 2017, Flowtite® GRP Pipe Systems Cleaning, viewed 27 April, 2017 http://www.iplex.com.au/iplex.php?page=lib&lib=31&sec=232&chap=302

[3] New England Interstate Water Pollution Control Commission 2003, Optimizing Operation, Maintenance and Rehabilitation of Sanitary Sewer Collection Systems, viewed 25 June 2020, https://www3.epa.gov/npdes/pubs/sso_optimizing_enitre_doc.pdf

[4] Insituform Technologies, LLC 2018, Inspection and Cleaning Guide for Cured-in-Place-Pipe (CIPP)-lined Pipes

[5] Wright, D., Wolgamott, J., & Zink, G. (2005) Safe Waterjet Cleaning of Sewer Pipe, WJTA American Waterjet Conference, Houston, TX, August 21 – 23, 2005

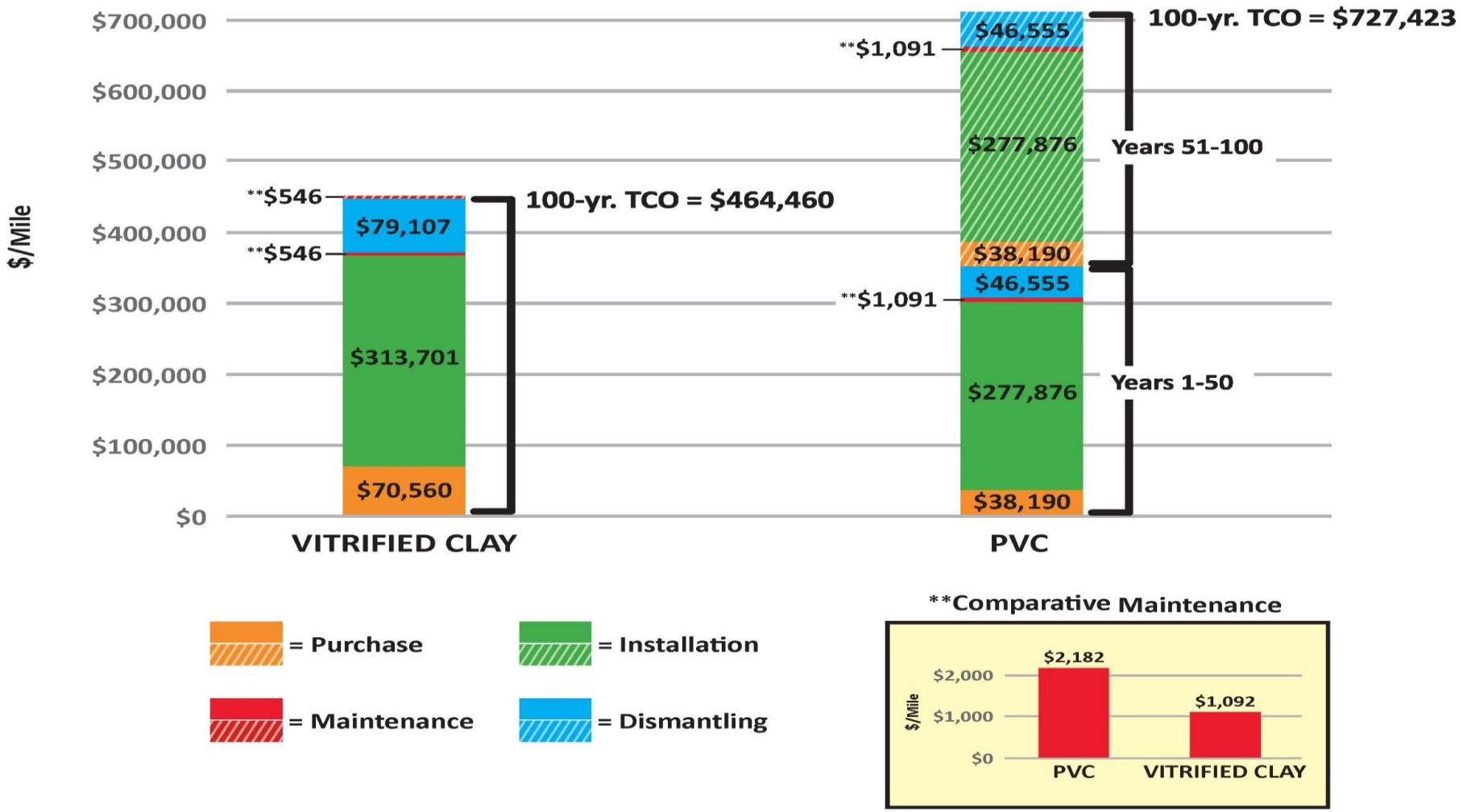
[6] Black & Veatch Corporation for ASCE and U.S. EPA 2004, Sanitary Sewer Overflow Solutions, http://www3.epa.gov/npdes/pubs/sso_solutions_final_report.pdf

COMPARATIVE TOTAL COST OF OWNERSHIP* (TCO)

For 100 Years of Sewer Pipe Service

For DN 315 mm (12-inch) pipe

*Total Cost of Ownership data from PVC4Pipes.com



**Comparative Maintenance

Allowable tooling per material set by:

- EPA
- Pipe Manufacturer’s Guidelines
- Trade Industry Associations
- Tooling Manufactures


City of Chicago, IL
City of Lansing, MI
City of Tulsa, OK
QUESTIONS
DISCUSSION
City of Chicago, IL
City of Omaha, NE
San Francisco PUC

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