



# Keyhole Technology Coring and Reinstatement Process

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**By:**

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**Gas Technology  
Institute (GTI)**



## WHO WE ARE

# Gas Technology Institute (GTI)

- > Leading U.S. research, development, and training organization serving the natural gas and energy markets
- > Headquarters: Des Plaines, IL
  - 300,000 sq-ft facility, 18-acre campus



**Exploration & Production  
Technology**

**Distribution & Pipeline  
Technology**

**Non-conventional Fuels**

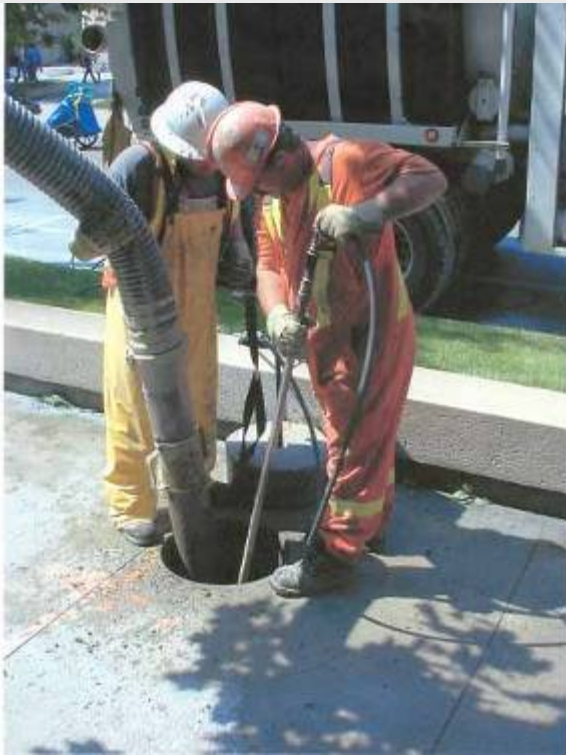
**End Use  
Solutions**

**Serving the Energy Industry Since 1941**



# What is Keyhole Technology?

- > Method of accessing or viewing underground utilities through small holes or “keyholes”
- > Vacuum excavated through soft surfaces or through holes cored through pavement.



# Why Keyhole and Coring?

- > **A better, smarter and environmentally sensitive way of making and repairing utility cuts through pavement to:**
  - Reduce delays and disruption of traffic and public inconvenience during roadwork
  - Minimize damage to roads
  - Reduce impact of public works construction on the environment
  - Facilitate repairs to underground utilities
  - Improve worker safety and productivity through better excavation methods
  - Avoid damage to underground utilities during excavation or HDD (*“Potholing”*)
  - Locate and map underground utilities (S.U.E.)
  - Save utilities and their contractors time and money

# Coring and Reinstatement History

- > **1988:** Consumers Gas (Toronto) uses *Keyhole Technology* for cathodic protection, leak repair and main separation;
- > **1990:** Rotary Coring equipment developed in Heavy Equipment Shop to cut 18" dia. x 18" deep;
- > **1993:** "Cookie Cutter Grout" developed, tested & approved by *Ontario Ministry of Transportation (Feb. 1994)*;
- > **1992-95:** 892 keyhole jobs successfully performed;
- > **1996:** Metro Toronto authorizes Pilot Project;
- > **1998:** GRI Distribution Meeting, Consumers Gas demonstrates coring and reinstatement;
- > **2001 - Current:** Utilities throughout North America start adapting keyhole practices



*Photo: Paul Sacristan, Michcon, July 22, 1998, Toronto*

**Consumers Gas "Cookie Cutter"**

## **THE FIRST DEMONSTRATION**

*July 22, 1998: Consumers Gas demonstrates to GRI its field operational crew truck with a special circular, asphalt cutter for keyhole maintenance jobs.*

# Coring & Reinstatement Process



- > Truck, trailer, portable, or skid-steer mounted coring units cut circular holes through the roadway for locate, depth checks, and/or potential HDD conflict sites (gas, water, sewer, fiber optic cable etc.).

# Remove the core

- > Once the core has been cut through ...
- > a core puller is used to remove the core;
- > The core is set aside (to be reinstated later).



# Cores of Different Depths and Compositions



**Thin Asphalt**



**Thick Asphalt**



**Thick Composite and Reinforced Concrete**



# Expose Underground Facilities and Perform Necessary Work



gti<sup>®</sup>

Rockville, MD

# A Few Keyhole Activities...

- > Daylight in advance of directional drilling work
- > Pothole/depth check
- > Sub-surface utility engineering (SUE)
- > Service terminations
- > Anode installation (cathodic protection)
- > Leak repairs
- > New and replacement services
- > And more...

# Core Reinstatement

**Backfill & Compact**



**Bonding Compound**



**Core Placement**



**Finished Repair**

# Completed Repair



The road can be safely reopened in **30 minutes!**

gti<sup>®</sup>

*... with no subsequent repaving required*

# Evaluation of Coring Process

- > Testing has been performed by several agencies
  - GTI
  - Univ. of Illinois
  - Golder & Assoc.
  - US Army Corps of Engineers



**Accelerated loading**



**Slant shear & punch out tests**



# Evaluation of Coring Process



**Core Reinstated 1995**

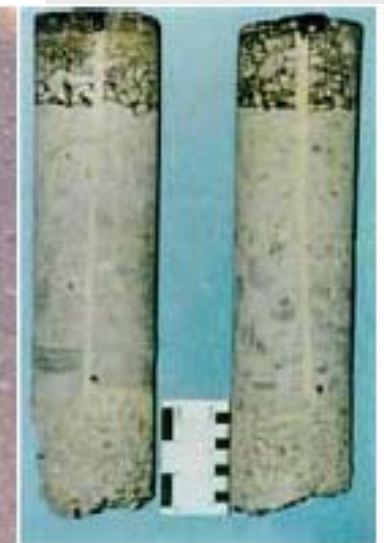
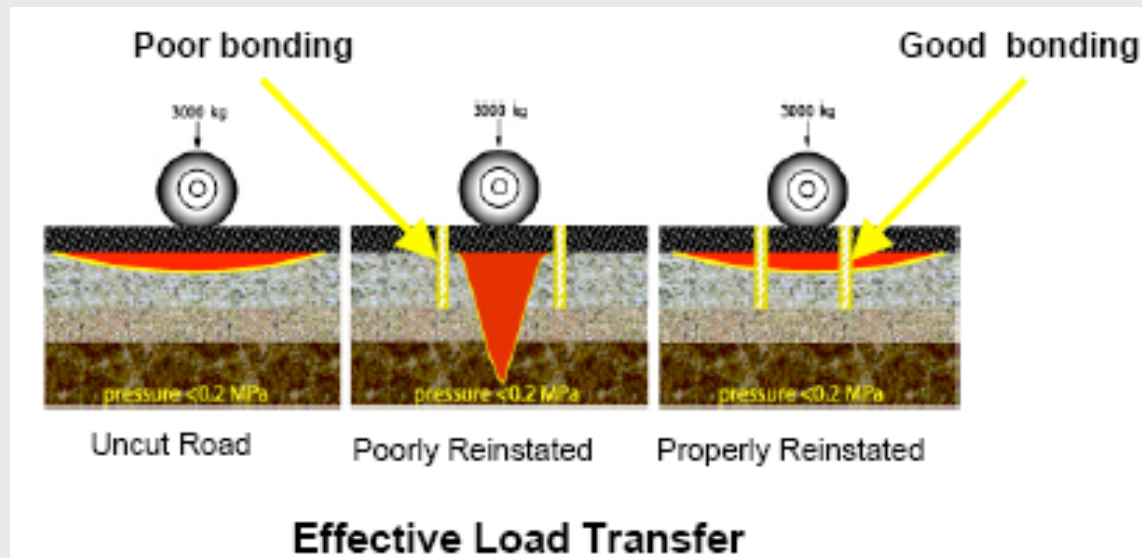


**Same Core 2003**

**“Since the initial reinstatement, more than 145,000 transit buses and more than 13 million commercial and other vehicles have passed directly over the keyhole with no apparent weakening or other degradation of the reinstated core or the adjacent road system or paved surface.”**

**Golder Associates April 21, 2003**

# Evaluation of Coring Process



Long Term Performance through freeze-thaw cycles

Mechanical Bond  
No Voids

# Evaluation of Coring Process

## Restoration of Utility Cut Study

- Collaboration project of North American cities, utility companies and U.S. State Departments of Transportation (2000-2005).
- **Objective:** to develop a guide for best utility cut restoration practice based on sound engineering principles.

### *Toronto Field Experiment: Observations*

#### CONVENTIONAL TRANSVERSE TRENCH

- Noticeable failures in conventional cut.
- Conventionally repaired joint between road and the cut opened.
- Visible settlement in trench along wheel path.
- Material used to seal joint lost under action of traffic.
- Sand cover at base of trench exposed to higher than normal levels of moisture (compared with keyhole).

#### CORED KEYHOLE

- No defects in keyhole cut.
- Keyhole section established Oct. 2001 continued to perform well throughout life of project.
- Surface of restored keyhole remained level with the road profile.
- The Utilibond material surrounding the AC/PCC core remained intact (no cracking or separation).
- Waterproof bond.

“Keyhole construction [is an] effective restoration technique that should be encouraged whenever feasible to minimize need for opening large trenches in the future.”



# Utilities Using Keyhole Technology

- > Alagasco
  - > Atlanta Gas & Light
  - > Atmos Energy
  - > Baltimore Gas & Electric
  - > Centerpoint Energy (Houston)
  - > Centerpoint Energy (Minnegasco)
  - > City of Des Moines Water Dept.
  - > Colorado Springs Utilities
  - > Connecticut Natural Gas
  - > Consolidated Edison
  - > Enbridge Gas Distribution
  - > Energy East Corporation
  - > Equitable Gas
  - > Keyspan Energy Delivery
  - > Las Vegas Valley Water District
  - > Michcon (DTE)
  - > National Grid
  - > Nicor Gas
  - > Northwest Natural
  - > Pacific Gas & Electric
  - > PECO
  - > Philadelphia Gas Works
  - > Questar Gas
  - > Sempra Energy
  - > Southwest Gas
  - > UGI Utilities
  - > Washington Gas Light
- Under Review**
- Consumers Energy
  - Cinergy (DUKE)
  - Dominion East Ohio Gas
  - Knoxville Utilities
  - National Fuel Gas
  - NSTAR
  - NYSEG
  - Oklahoma Natural Gas
  - People's Gas
  - South Jersey Gas
  - WE Energies
  - Xcel Energies

# Trenchless Technologies

- > Not really trenchless...
- > HDD and trenchless type installation of utilities have started to pick up steam again over the last year and a half due to an increase in replacing aging infrastructure and a great increase in the last mile fiber-to-the-home projects.
- > There is a substantial existing network of utilities and cable that drilling crews need to avoid.
- > Potholing must be performed to ensure utilities marked by “One Call” are accurate.



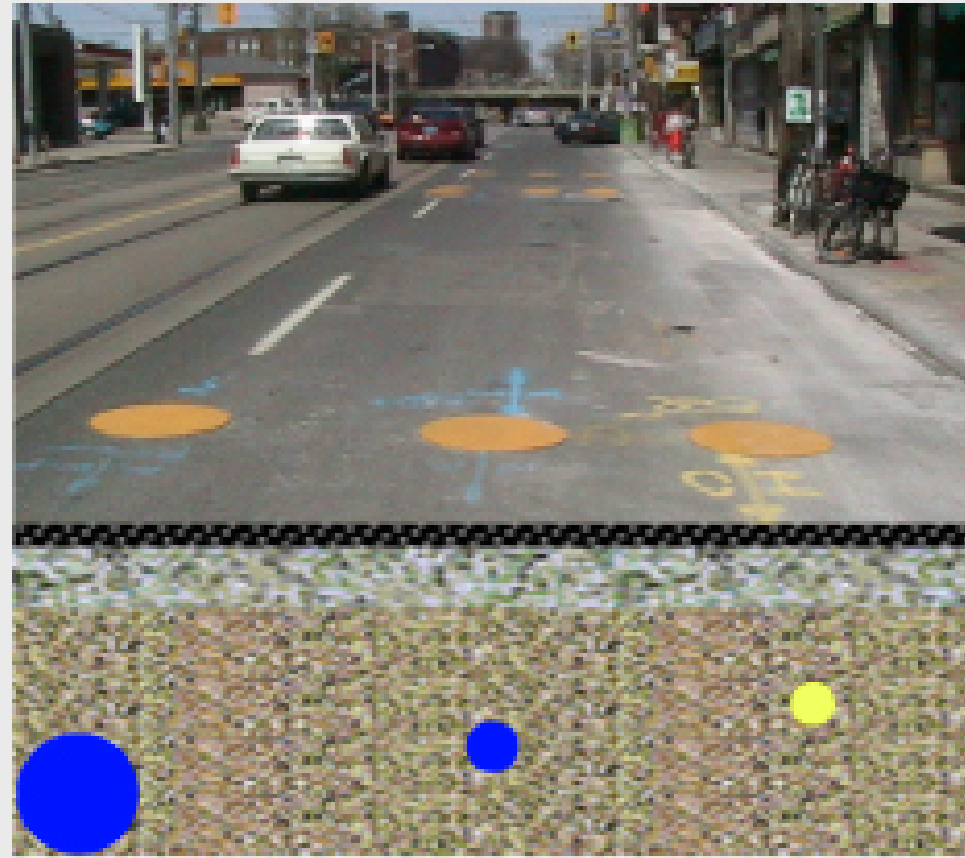
# Current Method of Inspection for HDD



- > With current methods...
  - Greater traffic disruption and degradation to our road infrastructure
  - More complaints and return trips



# Potholing for HDD – Cored Openings



- > One contractor performing over 2500 cores in 2006
- > About 80% are for inspection purposes only

# City of Des Moines Water Dept.

- > City of Des Moines Water Department utilizing Keyhole Technology to cathodically protect their water mains
  - Coring the pavement
  - Using long-handled brazing tool to install anodes
  - Result – reduction in cracked mains



# Coring Aesthetically Pleasing



**Creates favorable impression with municipality and public**

- > **Cored and reinstated access hole almost invisible in the foreground. (Permanent)**
- > **Conventionally repaired sidewalk cut in background. (Temporary)**
- > **No unsightly cut “reminders” or potholes.**
- > **No stress cracks or other failures.**
- > **No “slip, trip and fall” litigation.**



# Environmental Benefit of Coring and Reinstatement Process

- > **Reuses the same material, in the same form, to repair pavement**
  - no additional processing needed
  - no additional energy consumed
- > **No pavement spoil to be trucked away to dump site**
- > **No new pavement laid, no milling & overlay, no slurry etc.**
  - no volatile organic compounds to evaporate
  - fewer emissions
  - no additional energy or oil consumed in producing/heating HMA
- > **Shorter and Fewer Road Closings**
  - road can be safely reopened to traffic in 30 minutes
  - permanent repair -- no additional site visits
  - reduced inspection & traffic control requirements

“It’s not  
easy being  
green.”





# Coring – Win/Win Technology

## FOR THE UTILITY/CONTRACTOR

- > **Saves Time & Money:** Permanent repair – no return trips to repave.
- > **Positive Community Relations:** Faster, less intrusive process. Fewer complaints from municipalities about traffic disruption, unsightly road cuts, sunken patches or weakened or failed roads.
- > **Improved Logistics:** Single crew, one-stop, same-day coring and pavement reinstatement means simplified scheduling, no temporary patching or repaving and no repeat visits.
- > **Field-Proven Process:** More than 15 years and over 50,000 successful corings in tough urban climates.

## FOR THE CREW

- > **Easy to Operate:** No extensive training required.
- > **Easy on the Back:** Physically less demanding, no jack-hammers, shovels and backhoes. Reduces potential for workplace injury.
- > **Easy to Use:** Just add water, mix and pour.
- > **Time:** Can reopen the road in as little as 30 minutes.

# Coring – Win/Win Technology (cont.)

## FOR THE COMMUNITY

- > **Reduced Traffic Disruption:** Faster, one-step permanent pavement repair means reduced traffic congestion with fewer and shorter road closings and no repeat visits.
- > **Reduced Footprint:** Neat, almost invisible 18-inch diameter circular core (less than 1/4 the size of conventional road cut) means less scarring of the landscape and better pavement performance (no corner cracks).
- > **Environmentally Friendly:** No road-cut spoil to be disposed of and no temporary patching compounds with volatile organic compounds (VOCs) to escape into the atmosphere.
- > **Cleaner, Safer, Less Intrusive Worksite:** No jack-hammers or large excavation equipment means less mess during and after excavation and reduced disruption for neighbors.

# Coring Acceptance/Approvals

## **Current Status:**

- > Jurisdictions slow or resistant to accept the process of coring and replacement of the core**
- > Users of the R.O.W. do not want to embrace new technology without approval and/or encouragement from jurisdictions**
- > Change is difficult**
- > For this excavation and restoration process to succeed and make an impact we need your help**

# Questions and Comments?

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