

## KEYHOLE TECHNOLOGY

Gas distribution companies spend more than one billion dollars per year on excavations to install, replace, or repair gas mains and services. Typically, excavations (bellholes) cover an area about three feet by four feet, and are especially expensive and disruptive in urban areas when they must cut through pavement, which must then be restored. Conventional excavation practices — usually performed using several large pieces of equipment (backhoes, dump trucks, pavement breakers, etc.) — can account for 80% of the total cost of a repair job.

For several years, utility companies have been realizing significant excavation and pavement restoration cost savings by conducting repairs through small “keyhole” openings made through the pavement. These keyholes (openings from 6" to 18" in diameter) minimize disruption for the general public, are less costly to initiate, and allow for less expensive pavement restorations.

Especially applicable in urban environments, keyhole technology involves the use of pavement cutting, vacuum excavation, maintenance tools, and other technologies that allow operators to make repairs through small openings. However, keyhole technologies are not fully used by the gas industry because many companies are not familiar with them. In response, Gas Technology Institute (GTI) is providing information on keyhole case studies.



### KEYHOLE PRACTICES

Keyhole practices differ from those used in conventional bellholes because smaller excavations require precision, special techniques, innovative tools, and



methodologies — some of which are still under development or need to be developed. While individual utilities and contractors have developed many keyhole technologies, the products are targeted to a specific company’s needs, therefore the resulting tools are custom made, expensive, and difficult to obtain.

GTI has established a collaborative research project with 17 utilities to analyze the current status of keyhole technologies. The overall goal of the program is to advance industry acceptance of small-hole work and make more tools and equipment available to the industry at lower costs.

Through GTI’s Keyhole Technology project, participants are kept on the cutting edge of new keyhole developments through a variety of technology transfer methods. Working with industry consortia, government agencies, and private concerns, GTI has developed and tested a number of technologies for keyhole applications and processes for main leak repair, service leak repair, new service connections, service replacement/insertion, and service abandonment. GTI has also conducted comprehensive research on safety aspects related to vacuum excavation and studies on measurement devices to assure proper soil compaction.

### FOR MORE INFORMATION

Dennis Jarnecke  
Institute Engineer  
Gas Technology Institute  
847-768-0943  
dennis.jarnecke@gastechnology.org  
[www.gastechnology.org](http://www.gastechnology.org)

KEYHOLE CASE STUDY

**Southern California Gas Company (SoCalGas)**

SoCal Gas' Distribution Technical Support Group — the Field Technologies Team (FTT) — decided to pursue an initiative, that when implemented, would produce significant operations and maintenance (O&M) cost savings. The initiative focused on reducing the cost of routine field activities that are labor intensive, including excavation and restoration activities.

The FTT subsequently undertook a technology initiative to evaluate the feasibility and cost effectiveness of applying keyhole technologies to existing field operation processes.

A search for keyhole tools and equipment was

conducted to determine what was commercially available and what needed to be designed and fabricated. The FTT procured, assembled, fabricated, and tested soil vacuum systems, a pavement coring unit, and various keyhole hand tools and materials.

**“The economic benefits are obvious when routine pipeline O&M activities are performed through an excavation 60-80% smaller than a standard 2'x3' bellhole.”**  
Gilbert Ching, SoCalGas

Currently, there are seven keyhole systems deployed throughout the SoCalGas territory. The activities now routinely performed are: potholing/depth checks, punch tee cap repair, meter guard installation, valve casing clean-out, and, to a lesser extent, cathodic protection test wire installation.

**SOCALGAS KEYHOLE BENEFITS: Estimated \$557,000, annually**

<b>Applications</b>	<b>Keyhole Technologies</b>	<b>Conventional Methods</b>	<b>Savings Information</b>
<b>Punch Tee Cap Repair</b>			
Man-hours	4	8	
Cost per unit	\$226	\$452	
<i>Savings per unit</i>			\$226
<i>Potential Jobs per Year</i>			950
<i>Potential Savings</i>			\$214,700
<b>Potholing/Depth Checks</b>			
Man-hours	1.70	4.50	
Cost per unit	\$96	\$254	
<i>Savings per unit</i>			\$158
<i>Potential Jobs per Year</i>			650
<i>Potential Savings</i>			\$102,700
<b>Electrical Test Station (ETS) Installation</b>			
Man-hours	3.25	6.50	
Cost per unit	\$183	\$366	
<i>Savings per unit</i>			\$183
<i>Potential Jobs per Year</i>			1,000
<i>Potential Savings</i>			\$183,000
<b>Meter Guard Installation</b>			
Man-hours	2.00	4.00	
Cost per unit	\$113	\$226	
<i>Savings per unit</i>			\$113
<i>Potential Jobs per Year</i>			500
<i>Potential Savings</i>			\$56,500

KEYHOLE CASE STUDY

**Michigan Consolidated Gas Company (MichCon)**

MichCon traces its roots to 1849 with the founding of the Detroit Gas Light Company. MichCon, a subsidiary of DTE Energy, is the nation's 10th largest natural gas local distribution company. With 18,900 miles of pipeline, MichCon delivers natural gas to 1.2 million Michigan families and businesses in over 500 communities.

MichCon has conducted a keyhole technology program since 1984 to improve its gas operations and maintenance program. Currently, keyhole technologies that are used in operations include: 1) service abandonment for steel and plastic services

and welded tees up to 2"; 2) all main types with flow control for pipe up to 2"; and 3) coring operations for creating 18" and 24" cores. Technologies are also used in restoration processes, pavement coring, and for cast-iron and steel main repairs utilizing Mueller clamps up to 6". Corrosion testing, installing anodes, and test wire utilizing 2" pilot hole or test holes are also used. MichCon is using keyhole technologies for installing and renewing services on steel mains up to 6" in diameter and on cast-iron mains. In addition, the company is working on utilizing the coring and vacuum equipment for meter move-out operations.

**“Our goal is to utilize the vehicles in the same manner we would a normal truck and back hoe.”**  
Mike Arioli, MichCon

**MICHCON KEYHOLE BENEFITS: Estimated \$4.3 million, annually**

<i>Applications</i>	<b>Keyhole Technologies</b>	<b>Conventional Methods</b>	<b>Savings Information</b>
<b>Service Abandonment</b>			
Labor Cost	\$200	\$260	
Restoration Cost	\$75	\$404	
Cost per unit	\$275	\$664	
<i>Savings per unit</i>			\$389
<i>Potential Jobs per Year</i>			1,764
<i>Potential Savings</i>			\$686,196
<b>Service Renewal</b>			
Labor Cost	\$500	\$677	
Restoration Cost	\$75	\$777	
Cost per unit	\$575	\$1,454	
<i>Savings per unit</i>			\$879
<i>Potential Jobs per Year</i>			2,202
<i>Potential Savings</i>			\$1,935,558
<b>Cast Iron Main Repairs</b>			
Labor Cost	\$450	\$597	
Restoration Cost	\$75	\$474	
Cost per unit	\$525	\$1,071	
<i>Savings per unit</i>			\$546
<i>Potential Jobs per Year</i>			2,994
<i>Potential Savings</i>			\$1,634,724

KEYHOLE CASE STUDY

**Enbridge Gas Distribution Company (EGD)**

One of the most challenging issue utilities are facing today is in the repair and maintenance of buried infrastructure facilities. EGD is committed to a philosophy of continual improvement through all facets of the organization by using keyhole technology related to their construction and maintenance (C&M) operations.

EGD currently performs 2,500-3,000 jobs a year utilizing keyhole technology. At present, keyhole applications are focused primarily on cast-iron mains that can be worked on in only unfrozen soil conditions. However, the potential for keyhole goes well beyond this and new technologies are continuously being investigated that would further improve EGD’s operations.

Several initiatives are currently in progress in developing new processes that can be utilized to perform routine maintenance on higher-pressure distribution systems, including steel and plastic gas mains.

**“Road and sidewalk excavations have been recognized as the most promising keyhole benefit, resulting in cost reductions ranging from \$400 to \$500 per excavation.”**  
 Gunther Prattinger  
 Enbridge Consumers

EGD’s initiative in particular has facilitated the development and testing of tools to install a ½" plastic service off of a plastic main through a keyhole application. The intention is to use these tools as part of the EGD service relay program where excavations in paved or finished ground can result in substantial savings to the company.

In the future, Enbridge will be exploring more cost-saving opportunities in the keyhole area.

**EGD KEYHOLE BENEFITS: Estimated \$1 million, annually**

Applications	Keyhole Technologies	Conventional Methods	Savings Information
<b>Excavations in Sidewalk or Road Surface</b>			
Excavation *	\$290	\$590	
Backfill material (unshrinkable fill)	\$105	\$215	
Reinstatement	\$115	\$155	
<i>Keyhole Savings per Job</i>			\$450
<i>Potential Jobs per Year</i>			500
<i>Potential Savings</i>			\$225,000
<b>Excavations in Grass Landscaped Area</b>			
Excavation *	\$200	\$520	
Backfill material (unshrinkable fill)	\$0	\$0	
Reinstatement	\$7	\$57	
<i>Keyhole Savings per Job</i>			\$370
<i>Potential Jobs per Year</i>			1700
<i>Potential Savings</i>			\$629,000
<b>Excavations not Requiring Unshrinkable Fill</b>			
Excavation *	\$290	\$590	
Backfill material (unshrinkable fill)	\$0	\$0	
Reinstatement	\$115	\$155	
<i>Keyhole Savings per Job</i>			\$340
<i>Potential Jobs per Year</i>			300
<i>Potential Savings</i>			\$102,000

\* with shoring for conventional method