

*23rd World Gas Conference, Amsterdam 2006*

**MUELLER CO. MAGIC BOX™  
IN-SERVICE POLYETHYLENE INSERTION MACHINE**

*B. KORTTE*

USA

## ABSTRACT

This paper details the features, functions and benefits of the Mueller Co. MAGIC BOX™ “Polyethylene Insertion Machine”.

The Mueller Co. MAGIC BOX™ is the first self-contained machine that performs work on polyethylene plastic gas mains from a single excavation site without the need for squeezing and building a temporary bypass line. This drastically reduces crew time, equipment needs, excavation permits, and site restoration expenses. The MAGIC BOX™ System is based on the Mueller Co. NO-BLO® method of no gas escaping into the atmosphere, or any disruption of service.

The Mueller Co. MAGIC BOX™ System operates on 2", 3" and 4" diameter IPS polyethylene pipe, even with valves or repair clamps in place. Metric conversion kits are available for 63, 75, 90 & 110mm size pipe. The MB is installed around the gas main and cuts out the section of pipe quickly and cleanly with externally operated slotted blades. A replacement piece of pipe preloaded in the MAGIC BOX™ machine can then be easily transferred into position and electrofused in place using most universal processors. Supported electrofusion fitting manufacturers include Friatec, Innogaz, and Central Plastics.

The Mueller Co. MAGIC BOX™ can be used to install polyethylene ball valves, remove a bad joint (including “cold” joints or failed electrofusion couplings), remove leaking service connections, replace a damaged section of pipe (such as a scratch, gouge, rock impingement, or temporary repair using a repair clamp).

The following areas will be outlined in regards to the Mueller Co. MAGIC BOX™.

- Product Background
- Development History
- Product Applications
- Construction of the MAGIC BOX™
- Current Users
- Additional Information

## TABLE OF CONTENTS

1. Abstract
2. Mueller Co. Magic Box™ In-Service Polyethylene Insertion Machine
  - Product Background
  - Development History
  - Product Applications
    - Current Procedure
    - The Magic Box™ Solution
    - Common Repair Procedures
  - Construction of the Magic Box™
    - Body Housings
    - Blades
    - Pressure Containment Seals
    - Purge & Pressure Test Valves
    - Grounding Terminal
    - Over Pressure Indicator
  - Current Users
  - Additional Information
3. Appendix
  - Insert Replacement Instructions

# MUELLER CO. MAGIC BOX™ IN-SERVICE POLYETHYLENE INSERTION MACHINE

## Product Background

When the need to perform repairs on existing polyethylene natural gas mains arises, common practice calls for external by-passes, “squeeze” points and multiple excavations to be utilized. This method can be both costly and time consuming. Due to the time and monetary constraints of this method, the innovative concept for the Mueller Co. MAGIC BOX™ was born.

The MAGIC BOX™ is a single compact lightweight aluminium repair device that performs multiple repair procedures on polyethylene pipe utilizing one small excavation. This is accomplished without the need for external by-passes. It currently can perform repairs on 2”, 3”, 4” and 63mm, 75mm, 90mm & 110mm polyethylene pipe with a maximum operating pressure of 100 psig.



## Development History

The original prototype for the MAGIC BOX™ was introduced in the mid-to-late 1990's by the Institute of Gas Technology (IGT) with funding provided by Southern California Gas Company. The project was adopted by Baltimore Gas and Electric Company (BGE) with continued management by IGT. Mueller Co. - Gas Products Division became the manufacture of choice for the MAGIC BOX™ and holds all patent rights to the MAGIC BOX™ and associated material.

The original MAGIC BOX™ prototype was designed to perform repairs on 2” polyethylene gas mains operating up to 100 psig. After multiple field evaluations and industry focus group studies the conclusion was made that the unit needed to perform work on a range of pipe sizes. The 2” MAGIC BOX™ prototype was redesigned to perform work on 2”, 3” and 4” polyethylene pipe sizes. This version was completed in early 2004 with the first production units sold in May of 2004.

There are currently 18 MAGIC BOX™ units being commercially operated today by the foremost gas utilities in the U.S., with a number of other gas companies evaluating the technology for future applications.

## Product Applications

### Current Procedure

When repairing PE gas mains, current practice requires a complex set of operations using multiple fittings and numerous pieces of equipment. (See figure 1) On average 20-30 steps are performed using this type of repair operation. These fittings are then left exposed to future third party damage by excavating equipment.

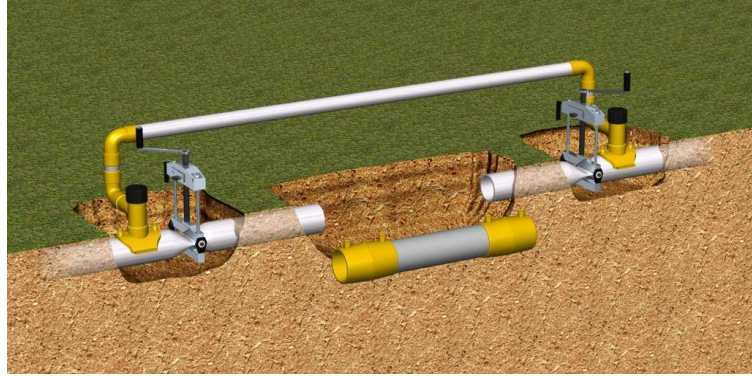


Figure 1

With this method a minimum of three excavations are required to shutdown and by-pass the gas around the section to be replaced or repaired. This requires one excavation site for the primary repair and two smaller excavations for the “squeeze and by-pass” locations. The restoration costs alone associated with repairing these excavations can add up very quickly. If this temporary by-pass is not constructed correctly, customers downstream of the repair could potentially be left without service, causing additional revenue loss.

In addition to these concerns, the pipe that is squeezed off during the repair operation needs to be identified as a squeeze point for maintenance purposes. This is usually accomplished with some type of repair clamp or identifying tape. Standard operating procedure does not allow a previously squeezed PE main to be squeezed again in the same location for fear of pipeline integrity issues.

### The MAGIC BOX™ Solution

The core function of the Mueller Co. MAGIC BOX™ is to remove an existing section of PE gas main and replace it with a new section of pipe. This procedure is accomplished under full continuous flow line pressure, up to 100 psig, without the need for external by-passes or “squeeze points”. The entire MAGIC BOX™



Figure 2

operation is performed in approximately 1 hour using a small excavation site of 4' x 6'. The MAGIC BOX™ can be used both laterally and horizontally which allows its use in joint trench operations.

The MAGIC BOX™ operation can be broken down into three basic steps. The phrase CUT, SLIDE, FUSE sums it up best. (See figure 3)

1. The MAGIC BOX™ **"CUTS"** a section of polyethylene pipe from the existing PE main.
2. It then **"SLIDES"** into place a new pre-loaded replacement piece of pipe or valve and fitting.
3. Finally it **"FUSES"** the preloaded electrofusion fittings to permanently replace the valve or section of pipe.

This all is performed with no interruption of gas service or any temporary by-passes or squeeze points. For detailed operation instructions please refer to the Operation Manual for the Mueller Co. MAGIC BOX™ In-Service Polyethylene Replacement Machine (Form #12358).

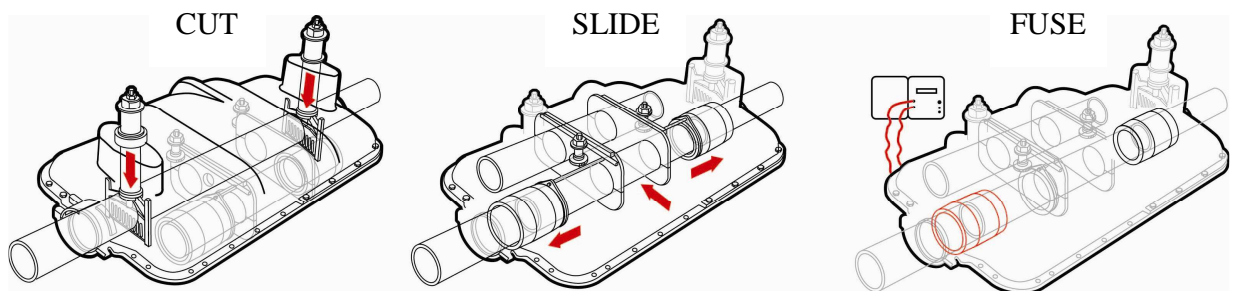


Figure 3

### Common Repair Procedures

Listed below are a few of the time saving repair procedures that can be performed with the MAGIC BOX™.

- Remove an existing section of PE gas main that has been damaged. This damaged could have occurred from a number of ways, such as third party damaged or rock impingement. In the United States, gas companies are required to make repairs on damaged PE gas mains with more than a 10% wall reduction.
- Install a PE ball valve into the gas line without the need for temporary by-passes or squeeze points, to increase system control and reduce system disruptions.
- Replace or remove an existing fitting from a PE gas line. Some examples are tees, ball valves, socket couplings, bad electrofusion couplings, etc.
- Remove a repair clamp that has been installed on a leaking PE gas main and replace it with a new section of pipe. The MAGIC BOX™ can accommodate up to a 12" long Mueller Co. repair clamp.
- Perform repair operations on older generation PE gas mains where "squeezing" is not a practical option due to crack propagation.

## Construction of the MAGIC BOX™

### Body Housings

The two halves of the MAGIC BOX™ are manufactured from high strength, lightweight aircraft grade aluminium castings. Four large lifting handles are built into both the top and bottom housings. These handles can be used to manually lift the unit into the excavation site. Lifting straps can be used if needed.



**Figure 4**

Both the bottom & top housings weigh approximately 100 lbs and can easily be handled by two people. The MAGIC BOX™ will always be moved in sections while the work is being performed at the job site.

Built into the top housing are three sight windows that allow the operator to monitor each step in the MAGIC BOX™ operation. All sight windows are field replaceable in the event they become scratched or damaged.

The two halves are secured by perimeter bolts that are threaded into replaceable steel inserts contained in the bottom housing. These inserts can be replaced in the field if damage occurs to the threads. Please see Appendix A for insert replacement instructions.

### Blades

The section of pipe to be removed is cut with externally operated slotted steel blades. These blades are lowered through the main using manually operated ratchets and sockets. Milled slots in the blades allow gas to continue flowing downstream while severing the section from the main. Each blade contains a hard stop which provides the operator with confirmation of a completed cut. The blades are also field replaceable if they become damaged.

## **Pressure Containment Seals**

Two perimeter o-rings seal the halves of the MAGIC BOX™. These o-rings are housed in machined grooves and provide a positive NO-BLO® seal. To seal each end of the MAGIC BOX™, gaskets are compressed around the pipe by two clamshell end glands that are bolted to steel inserts housed in the MAGIC BOX™ ends. These seals provide a NO-BLO® operation with every use.

## **Purge & Pressure Test Valves**

Threaded into each end of the MAGIC BOX™ are ¼ turn ball valves. These valves are used to perform a leak check once the MAGIC BOX™ is bolted together and ready for operation. They are also used to perform purging operations in the beginning and end of the MAGIC BOX™ procedure.

## **Grounding Terminal**

With each MAGIC BOX™ purchase a static electricity grounding rod is supplied. This grounding rod is attached to a terminal built into the bottom MAGIC BOX™ casting.

## **Over Pressure Indicator**

In the rare case of a pressure surge, an over pressure indicator is built into each MAGIC BOX™ unit. This valve automatically opens in the event the MAGIC BOX™ encounters pressure over the 100 psig maximum operating pressure.

## **Current Users**

There are currently seven large natural gas distribution companies in the United States using the Mueller Co. MAGIC BOX™ System. They are listed below.

- SOCAL “Southern California Gas & Electric”, Los Angeles, CA.
- PG&E “Pacific Gas & Electric, San Francisco, CA.
- AGL “Atlanta Gas & Light”, Atlanta, GA.
- Questar Gas, Salt Lake City, UT.
- Keyspan, New York, NY.
- PECO “Philadelphia Energy Company, Philadelphia, PA.
- Washington Gas, Washington, DC.
- Consolidated Edison, New York, NY.

A number of other natural gas utilities are currently evaluating the MAGIC BOX™ In-Service Polyethylene Replacement Machine for use in their PE distribution systems.

## **Additional Information**

To receive a MAGIC BOX™ information packet containing product videos and industry related articles please e-mail requests to Bryan Kortte at [bkortte@muellercompany.com](mailto:bkortte@muellercompany.com). The MAGIC BOX™ video can also be viewed at [www.muellercompany.com](http://www.muellercompany.com). Click on Gas Division and a link to the MAGIC BOX™ video will appear on the page.



## MUELLER® MAGIC BOX® INSERTION MACHINE

### Threaded Insert Replacement

Threaded inserts are used to reinforce bolt and screw holes in the aluminum housing of this machine. To replace a threaded insert:

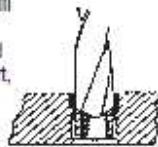
- Using the chart below, determine the Replacement Insert Number according to the location of the defective insert (the size of screw or bolt size that fits the insert also may be needed).

**Magic Box insert replacement chart**

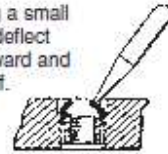
Thread Size of Bolt	Replacement Insert Number	Insert Location	Removal Data	
			Drill Size	Drill Depth
#10-32 UNF	312427-Service	Inside Housing	7/32"	5/32"
1/4-28 UNF	312426-Service	Inside Housing	9/32"	3/16"
5/16-18 UNC	312442-Service	End Gland - Clamp Retaining Bolt	11/32"	3/16"
1/2-20 UNF*	312393-Service	Housing - Perimeter Flange	21/32"	3/16"
1/2-20 UNF*	312394-Service	Housing - End Gland Flange	17/32"	3/16"

\* **Caution:** When replacing inserts for the 1/2-20 UNF size thread: The same thread size is used for the perimeter flange and the end gland bolting but uses a different insert, which, requires a different drill size.

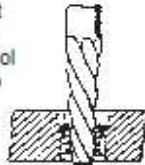
- Using the Drill Size and Drill Depth indicated in chart for insert, drill out locking keys.



- Using a small punch, deflect keys inward and break off.



- Remove insert with an E-Z Out type tool. Turn tool counterclockwise slowly.



- Thread replacement insert into original hole.



- Drive down locking keys with several light hammer taps directly on keys.

Illustrations used with permission from Carr Lane Mfg. Co., St. Louis MO.



Decatur, IL

Form 12403-4/05 Printed U.S.A.