

# Trenchless Methods for Service and Mainline Pipe Rehab and New Install

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Agenda

1. Company profile
2. Trenchless Overview
  - a) What is the problem?
  - b) Why is trenchless the answer?
3. Trenchless New Installation Options – Mainline & Service Line
  - a) HDD
  - b) Pit launched HDD
  - c) Horizontal boring tools
4. Trenchless Rehab Options – Mainline & Service Line
  - a) Split and Pull pneumatic system
  - b) Pull and Split winching system
  - c) Hydraulic pipe splitting system
  - d) Mini-winch splitting system
  - e) Mini-pipe splitter technology

**TT Technologies, Inc.**

Company Profile

- Trenchless construction equipment manufacturer
  - Pipebursting, Pipe Ramming, Horizontal Boring, Horizontal Directional Drilling, Etc.
- Trenchless is our ONLY business
  - Has been since 1991 (TT founded)
  - Technologies and experience since 1962
- Trenchless equipment used for:
  - Gas, Electric, Telecom, Water (sanitary, drinking and storm)

## What is the PROBLEM?

### Deteriorating pipe:

- Service lines
  - Plastics
  - Copper
- Main lines
  - Steel
  - Plastics
  - Cast Iron

## Do you have an Aldyl-A Problem?

Information Gathered from PG&E in California:

- Pacific Gas and Electric Co. has confirmed that segments of natural gas pipeline it is replacing in Marin are made of a plastic known since 1982 to be at high risk of failure under certain circumstances.
- Concern about the pipe, a DuPont product known as Aldyl-A, spiked last year after pipe failures resulted in two explosions, the first in a Cupertino condominium, and then less than a month later beneath a commercial intersection in Roseville.
- Gene Palermo, a former chemist with DuPont who now works as a private consultant, said DuPont notified PG&E in 1982 that Aldyl-A pipe manufactured before 1973 is prone to cracking. Palermo said if pre-1973 Aldyl-A pipe is pressed by soil against rocks or other hard surfaces, it can fail in as little as five years.
- Brittany McKannay, a PG&E spokeswoman, said all of the Aldyl-A pipe in Marin, some 51 miles of it, was made before 1973. PG&E is currently replacing 1,000 feet of pre-1973 Aldyl-A pipe in San Anselmo and is preparing to replace another 800 feet of the pipe in Mill Valley.
- In October 2011, following the Aldyl-A pipe failures that resulted in fires, PG&E announced it would replace 1,231 miles of the pre-Aldyl-A over the next three years.

## Trenchless Benefits

### Why Trenchless?

- Minimize the need to disturb existing environment, traffic, or congested living and work areas
- Use predetermined paths provided by existing piping, reducing the steering and control problems associated with new routing
- Requires less space underground, minimizing chances of interfering with existing utilities or abandoned pipes
- Provide the opportunity to upsize a pipe without open-trench construction
- Require less-exposed working area, and therefore, are safer for both workers and the community
- Eliminate the need for spoil removal and minimize damage to pavement and disturbance to other utilities

(from Trenchless Technology Pipeline and Utility Design, Construction and Renewal – Mohammad Najafi, Ph.D., P.E.)

**Trenchless New Installation**  
**Main and Service Line**

Three Primary New Installation Trenchless Options Available:

- HDD – Horizontal Directional Drilling
- Pit Launched HDD
- Horizontal Boring Tools

**Trenchless New Installation**  
**HDD – Horizontal Directional Drilling**

The diagram illustrates the HDD process. A rig labeled 'GRUNDODRILL 4X' is positioned on the left. It is connected to a series of 'DRILL RODS' that extend horizontally under a road. At the end of the rods is a 'REAMER' that has just finished creating a path for a new pipe. A red car is shown on the road above the drilling path.

**Trenchless New Installation**  
**HDD – Horizontal Directional Drilling**

Mini-HDD Drill Rig Benefits:

- Compact
  - Typically can fit through gated fence opening
- Portable
  - Easily transported with 1 ton truck and trailer
- Highly maneuverable
  - Due to size can navigate tight areas
- Extremely powerful for size
  - 9,800 lbs. of thrust and pullback
  - 1,100 ft-lbs. of rotational torque
- Install new pipe up to 6” in diameter

**Trenchless New Installation**  
**HDD – Horizontal Directional Drilling**

Length = 130”  
 Width = 35.5”  
 Height = 70.5”  
 Weight = 4,100 lbs.

The image shows the Mini-HDD Drill Rig in two contexts. On the left, it is mounted on a trailer and being towed by a truck. On the right, there is a close-up photograph of the rig itself, showing its compact size and various mechanical components.

**2008 HDD Data**

		Cost/ft.
Total Pipe installed (includes main&serv.)	32,576ft.	
Actual 2008 employee labor w/fb & pr taxes (includes mgmt. & rep., OT, 100% FB adder)	\$518,338	\$15.91
HDD Machine Cost	\$126,767	
HDD Trailer (from STS Trailer Sales)	<u>\$14,000</u>	
Equipment Total	\$140,767	\$4.32
Crew Truck cost (\$1,100x12 months)	\$13,200	
Pick-Up Truck Cost (\$750x12 months)	<u>\$9,000</u>	
Vehicle cost	\$22,200	\$.68
<b>Totals</b>	<b>\$681,305</b>	<b>\$20.91</b>

Note: Approx. 3,000 ft of main was installed in RI

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**2008 HDD Cost Saving Calculations**

- 2008 Central Region conventionally installed 33,175 ft of replacement main by in-house crews at \$96.41/ft
- 2008 Ave cost to install new services conventionally by in-house crews was \$2,314 per service, ave length per service was 75 ft, or \$30.85/ft.
- Weighted average cost per foot for repl. main and new services above is \$53.06. (This is the work included in the HDD cost per foot on previous page)
- The above main job costs include tie-ins, which is not in the HDD costs.
- Assuming it costs approximately \$10/ft. for the main tie-ins, savings potential could be (\$53.06 -\$10= \$43.06 vs. HDD cost/ft. \$20.91) \$22.15/ft.

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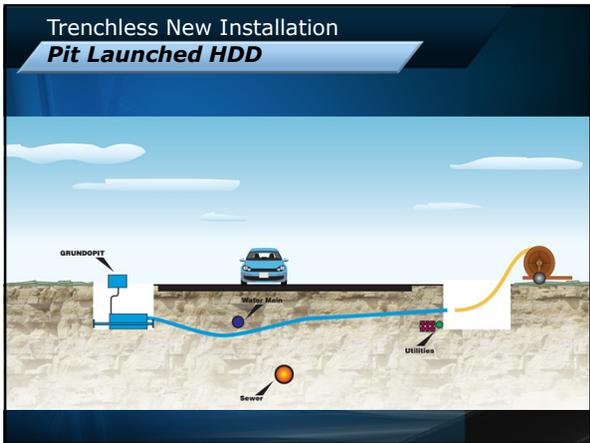
### 2008 HDD Cost Saving Calculations

- So, for discussion sake, we should estimate a conservative range of savings from \$10/ft to \$20/ft based on the previous bullet of \$22.15/ft in savings.
- Assuming we will install another 32,500 ft, potential cost savings could be from \$325,000 to \$650,000 annually.
- The payback for the \$140,767 equipment cost could be achieved by installing as little as 7,038 ft to as much as 14,076 ft, based on the cost savings range from above.

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### Trenchless New Installation

#### HDD – Horizontal Directional Drilling



### Trenchless New Installation

#### Pit Launched HDD

#### Pit Launched HDD Drill Rig Benefits:

- Highly portable
- No setback required
  - Size is ideal for urban setting
- Extremely powerful for size
  - 8,800 lbs. of pullback
  - 13,200 lbs. of thrust
  - 665 ft-lbs. of rotational torque
- Install new pipe up to 4” in diameter

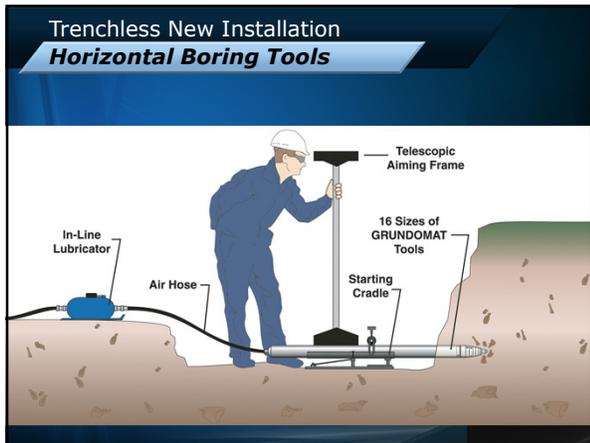
### Trenchless New Installation

#### Pit Launched HDD

Length = 44”  
 Width = 18.75”  
 Height = 14.5”  
 Weight = 440 lbs.

### Trenchless New Installation

#### Pit Launched HDD



**Trenchless New Installation**  
**Horizontal Boring Tools**

- New Service Installs – (PE, Copper, New Bendable Multilayer Composite Pipe)
- Less Excavation & Restoration
- Lower Cost Alternative
- High Production

- Pull Pipe
- Drive Pipe
- Burst Pipe
- Reversible
- Accurate

**Trenchless New Installation**  
**Horizontal Boring Tools**

### Safety

- Locate Peripheral Utilities
- Clearly Mark
- Good Communication
- Someone Always Attending to Air Supply
- ALWAYS Pot-Hole When Crossing Utility
- Minimum Depth

**Trenchless New Installation**  
**Horizontal Boring Tools**

### Safety

Working Depth for Bores

**Trenchless New Installation**  
**Horizontal Boring Tools**

### Tools Specs and Sizes

- Diameter: 1 3/4" through 7"
- Weight: 19 lbs. through 573 lbs.
- Length: 39" though 87"
- Piston Stroke/Min.: 580 through 280

**Trenchless New Installation**  
**Horizontal Boring Tools**

### What about ACCURACY?

Reciprocating Head vs. Solid Head Tool

### Trenchless New Installation Horizontal Boring Tools

Tool Lubrication

- In-line lubricator used
- Lubricant travels in the air system
- Promotes long tool life
- Biodegradable, non-toxic air tool lubricant



### Trenchless New Installation Horizontal Boring Tools



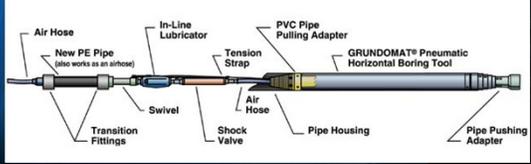

### Trenchless New Installation Horizontal Boring Tools




### Trenchless New Installation Horizontal Boring Tools

Pipe Extraction

- Remove Existing Line
- Pipe Pushing Adapter
- Receiving Pit for Old Line



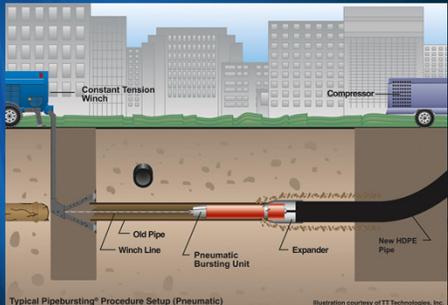
Labels in diagram: Air Hose, New PE Pipe (also works as an air hose), Transition Fittings, In-Line Lubricator, Swivel, Shock Valve, PVC Pipe Pulling Adapter, Tension Strap, GRUNDOMAT® Pneumatic Horizontal Boring Tool, Air Hose, Pipe Housing, Pipe Pushing Adapter.

### Trenchless Rehabilitation Mainline and Service Line

Numerous Trenchless Rehab Options Available:

- Split and Pull pneumatic system
- Pull and Split winching system
- Hydraulic pipe splitting system
- Mini-winch splitting system
- Mini-pipe splitter technology

### Trenchless Rehabilitation Split & Pull Pneumatic System



Labels in diagram: Constant Tension Winch, Compressor, Old Pipe, Winch Line, Pneumatic Bursting Unit, Expander, New HDPE Pipe.

Typical Pipebursting® Procedure Setup (Pneumatic) Illustration courtesy of TT Technologies, Inc.

**Trenchless Rehabilitation**  
**Split & Pull Pneumatic System**

Typical Jobsite

**Trenchless Rehabilitation**  
**Split & Pull Pneumatic System**

Development of the System

- Southwest Gas Corporation (SWG) began using the “Split & Pull” method in Northern Nevada in 2001
- One year later they determined the “Split & Pull” method with the “keyhole” process would significantly improve efficiency
- Other Benefits:
  - Substantial reduce pavement restoration costs
  - Improve relationships with customers and enforcement authorities

(Information provided by SWG)

**Trenchless Rehabilitation**  
**Split & Pull Pneumatic System**

Average Pavement Restoration Required per Linear Foot of Pipe Replacement

Method	Square Footage of Pavement
Open Trench	3.8
Directional Bore	1.8
Split & Pull	1.2
Split & Pull w/Keyhole	0.5

Information Provided by SWG

**Trenchless Rehabilitation**  
**Split & Pull Pneumatic System**

Cost Saving Example

**Open Trench:**  
 500’ of PVC Main w/10 Services  
 $500 \times 3.8 = 1,900$  Square Feet of Pavement Restoration Required

**Split & Pull w/Keyhole:**  
 500’ of PVC Main w/10 Services  
 $500 \times 0.5 = 250$  Square Feet of Pavement Restoration Required

Information Provided by SWG

**Trenchless Rehabilitation**  
**Split & Pull Pneumatic System**

Development of the System

- In 2007 SWG began discussion with TT Technologies to research and develop additional tooling and processes for the “Split & Pull” method
- The main focus was to develop and refine tooling and equipment that could split 2” PVC/PE and pull in 3” PE sleeving in one process at greater distances

**Trenchless Rehabilitation**  
**Split & Pull Pneumatic System**

The Process

- A winch at the receiving pit which provided
  - Pulling assistance for a pneumatic tool
  - Improved guidance
- A pneumatic tool consisting of
  - Splitting head
  - Lubricating jets
  - Expander
  - Coupled to 3” sleeving

**Trenchless Rehabilitation**  
**Split & Pull Pneumatic System**

**Pre-Inspection**

Prior to performing any "Split and Pull" process, a live insertion camera is utilized to verify there are no obstructions within the pipeline that would hinder the process.

- Examples: drops, offsets, repair couplings, etc.

**Trenchless Rehabilitation**  
**Split & Pull Pneumatic System**



The left photograph shows a blue trailer-mounted machine with a large vertical shaft being lowered into a trench. The right photograph shows two workers in safety vests standing at the edge of a trench, with a yellow hose or cable extending into the ground.

**Trenchless Rehabilitation**  
**Split & Pull Pneumatic System**



Three close-up photographs showing the mechanical components of the system. The top-left photo shows a worker's hands connecting a cable to a metal toolhead. The top-right photo shows a similar toolhead being used in a trench. The bottom photo shows a cylindrical metal component with a longitudinal slot.

**Trenchless Rehabilitation**  
**Split & Pull Pneumatic System**



Two photographs showing the pipe installation. The top photo shows a yellow and silver pipe being pulled through a trench. The bottom photo shows workers at the surface connecting sections of the pipe.

**Trenchless Rehabilitation**  
**Split & Pull Pneumatic System**

**Field Trials**

First field trial June 2009

- 150' of "Split and Pull" on PVC pipe while installing 3" sleeving
- Time to complete the installation was approx. 2 hours

Second field trial August 2009

- 300' of "Split and Pull" on PVC pipe while installing 3" sleeving
- Time to complete the installation was approx. 41 minutes

Both pulls were performed in caliche type soil

**Trenchless Rehabilitation**  
**Split & Pull Pneumatic System**

**Project Goals**

The goal at SWG is to complete 300'- 500' per day, including all affected services.

**SWG WAS ABLE TO MEET THIS GOAL AND CURRENTLY HAS NUMEROUS CREWS UTILIZING THE SPLIT & PULL PROCESS.**

**Trenchless Rehabilitation**  
**Pull & Split Winching System**

Upgraded Systems with more Power for

- longer runs
- tougher soils
- larger service diameters
- 12 ton (24,000 lbs.) pull back or more
- Constant Tension Winch (twin capstans)

GRUNDOWINCH®

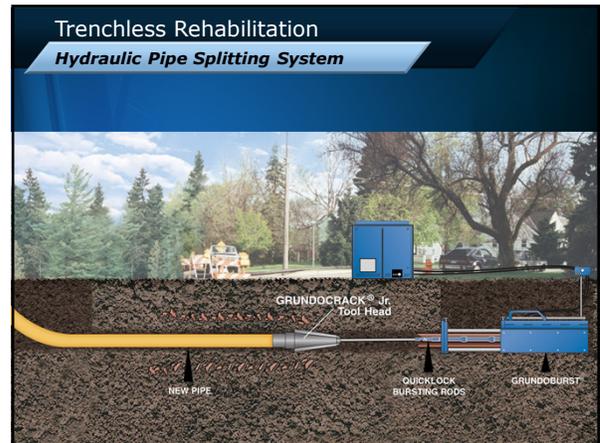
GRUNDOCRACK® Jr. Tool Head

New Pipe

Old Pipe

Winch Line





Trenchless Rehabilitation  
**Hydraulic Pipe Splitting System**

- Equipment is powered by a hydraulic power pack
- “Quicklock” bursting rods are guided through existing host pipe with a “guide rod” and attached to new pipe which is pulled back towards you
- While pulling back the “Quicklock” burst rods, the tool and expander fracture the host pipe, displacing the fragments into the surrounding soil while pulling in the new pipe with forces up to 600,000 lbs.

Trenchless Rehabilitation  
**Hydraulic Pipe Splitting System**

- Can burst and replace fracturable and malleable pipe (i.e. Ductile Iron, Steel, VCP, concrete, PVC, RCP, cast iron, liners, etc.)
- Can install a variety of new product pipe (i.e. Ductile Iron (restrained joint), HDPE, PVC (fusible and restrained joint), clay (jacking pipe), etc.)

Pipebursting® Technology  
**What is Pipebursting ?**

Pipe bursting is the eco-friendly trenchless method which replaces existing host pipes by displacing their fragments into the surrounding soil while simultaneously pulling in new product pipe of the same or large diameter into the void created.

Pipebursting® Technology  
**Soil Conditions**

**BEST**

- Original backfill
- Expandable clay
- Loose cobble
- Beach & running sand

**DIFFICULTY**

- Densely compacted clay
- Sandstone

**WORST**

\* Need the ability to expand and reduce soil friction and pipe drag

Pipebursting® Technology  
**Race Against Time**

*Pipebursting is a race against time ...*

- Need to expand enough to “overcut” and minimize “drag”. ex: 8” new pipe requires an 11” O.D. expander.
- Need stable soil conditions to maintain hole
- What if my soils are unstable?
  - Consider shortening burst runs
  - Possible pipe lubrication
  - Minimize downtime
    - » e.g. Consider using a fusion weld type pipe (PVC or HDPE) in lieu of a restrained joint cartridge load type pipe

Pipebursting® Technology  
**Lubrication**

**MAYBE**

**USE**

**ALWAYS**

- Small diameter, good soil
- Medium diameter
- Large diameter
- Large diameter, poor soil

Use polymers in clay soils  
Use bentonites in most other soils  
\* Contact your lubrication provider to discuss each project

Pipebursting® Technology  
**Original Trench Width**

- How was original pipe placed?
  - Was it placed in a rock trench?
  - Is there enough room for expansion?
  - What type of backfill and compaction?
- If crossing a road or highway ...
  - Is there a casing pipe?
  - Is there a concrete over pour?

Pipebursting® Technology  
**Adjacent Utilities**

- Ground movement during a pipeburst operation may damage nearby pipes and structures.
  - A general rule, both horizontal and vertical distance between the pipe to be burst and the existing adjacent pipe should be at least two diameters of the replacement pipe. (e.g. 8” to 10” pipeburst should be 20” clear (horizontal and vertical) from all utilities)

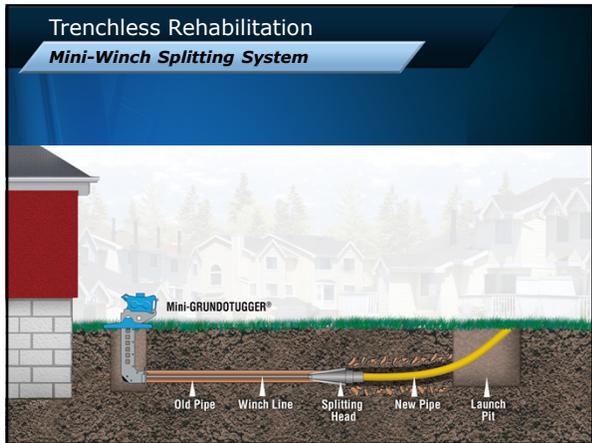
Pipebursting® Technology  
**Crossing Utilities**

- If crossing an existing utility with a pipeburst operation, exposing the utility to locate is **ALWAYS** proper protocol.
  - Pothole the existing utility to obtain proper alignment and depth clearance
  - If within the zone of pipebursting influence, proper care must be taken to protect the existing utility
    - Vacuum excavate surrounding soil to relieve the influence on the existing utility

Trenchless Rehabilitation  
**Hydraulic Pipe Splitting System**



Standard Bursting Rod 2.13”

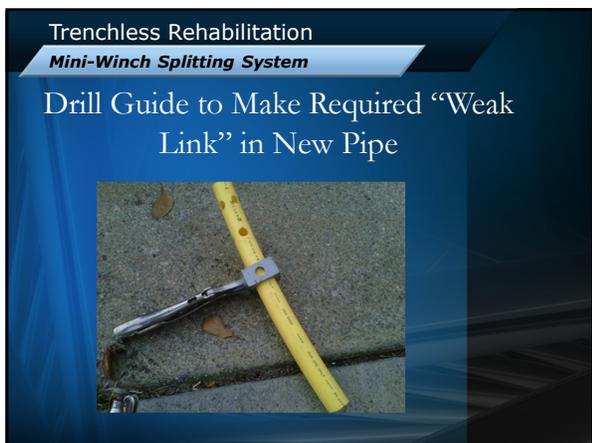




Trenchless Rehabilitation  
**Mini-Winch Splitting System**

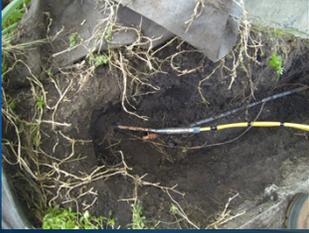
Case Study

- Replacement from Meter to the 2" Main at the sidewalk
- Temporary Service Maintained
- 2 small excavations
- 2-Bladed Cutter to split 1/2" Aldyl-A pipe
- Expander Body to Expand split pipe
- New 1/2" CTS PE Replacement Pipe pulled in



Trenchless Rehabilitation  
*Mini-Winch Splitting System*

Splitting Process Begins



Trenchless Rehabilitation  
*Mini-Winch Splitting System*

Old Riser Removed



Trenchless Rehabilitation  
*Mini-Winch Splitting System*

Old Connection to Meter Set



Trenchless Rehabilitation  
*Mini-Winch Splitting System*

Constant Tension Winch



Trenchless Rehabilitation  
*Mini-Winch Splitting System*

6 Ton Down Hole Pulling Power



Trenchless Rehabilitation  
*Mini-Winch Splitting System*

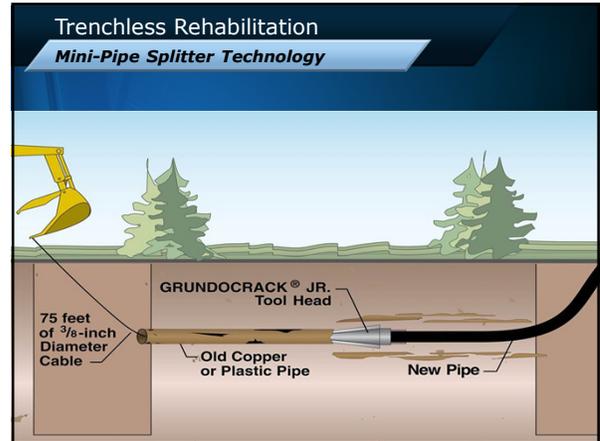
New Service Pipe



**Trenchless Rehabilitation**  
**Mini-Winch Splitting System**

### Case Study Conclusions

- New 25' service installed with minimal excavation
- Service can be replaced with 1/2" or 1"
- Aldyl-A pipe split successfully
- Service splitting accomplished in a few minutes
- No damage to the new service pipe





Pipebursting® Technology  
**Recommended Technical Publications**

- North American Society for Trenchless Technology (NASTT) – Pipe Bursting Good Practices Guidelines  
 – <http://www.nastt.org/mobk/7951>
- American Society of Civil Engineers (ASCE) – Manual of Practice for Pipe Bursting Projects  
 – <http://www.asce.org/Product.aspx?ID=2147485332>
- International Pipe Bursting Association (IPBA) – Guideline for Pipe Bursting  
 – [http://www.ipba.org/publications/specs/mainline\\_spec.pdf](http://www.ipba.org/publications/specs/mainline_spec.pdf)

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