Trenchless TECHNOLOGY®

SPECIAL REPORT
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TRENCHLESS TECHNOLOGY SOLUTIONS FOR NEW INSTALLATION CHALLENGES

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PROMOTING TECHNOLOGY IN THE UTILITY CONSTRUCTION INDUSTRY

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BY BRADLEY KRAMER

OFFERING TIPS FOR OVERCOMING NEW INSTALLATION CHALLENGES

Welcome to our new special report — *Trenchless Technology Solutions for New Installation Challenges.* Throughout this digital issue, we explore the evolution of trenchless installation methods for underground infrastructure, as well as provide a practical guide and tips for getting the job done safely and efficiently. Let's explore what you'll find inside.

We start off with a look at the benefits of trenchless technology vs. open cut methods for installing underground infrastructure on page 4. Our experts explain when trenchless techniques are the most optimal and how these methods improve safety, help save on costs and reduce environmental and social disruption.

Next, on page 6, we provide a look at the evolution of HDD over the last 50 years. *Trenchless Technology* managing editor Sharon Bueno writes about how this technology has become one of the most trusted methods of installing new infrastructure.

Looking further into these pages, you'll find informative articles on the use of vacuum excavators for utility locating, practical approaches to microtunneling, the evolution of auger boring and improving direct pullback operations on smaller diameter bores from this issue's sponsors. Thank you to Akkerman, Melfred Borzall, Michael Byrne Mfg., TRUVAC, for their support.

I hope you find this special report informative, and I wish you a safe and productive 2021.

Brad Kramer
Contributing Editor

BENEFITS OF TRENCHLESS CONSTRUCTION VS. OPEN-CUT METHODS

By Bradley Kramer

There are a number of solutions for installing underground infrastructure. These methods fall into one of two camps, trenchless and open-cut. While there is a time and place for each solution, trenchless methods offer a number of benefits over open-cut to meet project demands.

Whether a company is considering horizontal directional drilling (HDD), microtunneling, auger boring or any myriad other trenchless technologies for a new installation project, the primary benefits of these solutions are the ability to eliminate disruptions to people's lives, minimize environmental impacts and save on costs in the long run, says John Gregor, horizontal directional drilling supervisor for Miller Pipeline, an Artera company.

When working in residential areas, especially older established neighborhoods, Gregor says that using trenchless methods to install a gas line or sewer pipe helps minimize the inconvenience people endure when construction occurs on their street.

"When you're going in to an area to install a drainage system, a sewer or replace a piece of pipe, if you have to tear all that out with open cut, you end up with a bunch of equipment on the street," Gregor says. "It's just a mess and the people there get upset. If you have a directional drill, you have a hole on one end and then one on the other, and there's no mess and no headache."

Using open cut to dig up infrastructure causes tremendous disruption to a neighborhood, Gregor says. Between the dug-up holes and amount of equipment and crew on the jobsite, people can't get in and out of their driveways and could have their yards torn up. With trenchless, oftentimes they "never know you're there."

"Aside from making a few holes here and there where we have to plant new grass, it's all really about disruption prevention," Gregor says. "That's a huge benefit."

Gregor adds that the project owners — whether it's a municipality or utility company — appreciate those benefits as well.

"Our customers all realize the benefit of eliminating those disruptions, because they

take all the heat when there's an issue," he says. "The homeowner is contacting them if they have a problem."

Minimizing disruption also applies to more urban areas, says Dustin Kraft, regional manager at Vermeer and co-chair of the Trenchless Committee at the Distribution Contractors Association (DCA). He gives the example of installing pipe under a busy intersection.

"Rather than disrupting traffic flow for an extended period of time by cutting and digging up the road, burying the pipe and then repairing the road," Kraft says, "a directional drill can used to install the product under the road with minimal, if any, disruption to the road and/or traffic."

In addition to minimizing the disruption to people's lives, trenchless also helps mitigate the environmental impacts of an installation project, says Gregor, who is a 30-year veteran of the trenchless industry.

"With wetlands, and not just those that have been there forever, some wetlands are created for a purpose, and the last thing people want to do is dig that up to put a pipe there," Gregor says. "Instead, you can directional drill it and protect that wetland. Preserving natural resources is a huge benefit."

Kraft adds that sound pollution is another concern that trenchless methods, particularly HDD, helps reduce.

"In recent years we have seen growing demands from customers to make directional drills that are quiet," Kraft says. "Between the lower decibels we are seeing from today's directional drills at the machine and the fact the actual work is being done up to several hundred feet away from the drill and underground, this is being accomplished."

Reducing disruptions to society and impacts to the environment, Gregor says, also leads to cost savings over time.

"The cost of using open-cut across a river is phenomenal," he says. "With HDD, you can sit back hundreds of feet, dig under the river and come out the other side, and you're not disturbing that environment. It's also cheaper cost-wise."

However, Gregor cautions that there is some misconception that using trenchless technology is cheaper than using open-cut.

"That's not necessarily the case," Gregor says. "In terms of the long-term cost and eliminating disruption, it's definitely cheaper to drill than open cut."

In the short-term, however, there are a number of upfront costs that could be prohibitive, Gregor explains, such as the cost of the machinery and tooling, drilling additives and training people.

"That's a huge cost over having a backhoe and a bunch of laborers ripping a neighborhood up," Gregor says. "With trenchless, you might need a vacuum truck on site, or the tooling wears out. It's not cheap. It might cost a few more bucks to drill than open-cut, so you have to convince the customer in the long-term it's the better way to go."

Gregor says that factoring in the long-term cost of the equipment is an important part of determining the total cost of a project.

"You can charge all that to the job," he says.

With an open-cut project, ground settling around an installation site could pose a problem that might lead to unexpected costs in future, such as road repairs or yard maintenance.

"With a big open-cut job, you may end up having to fix something five years down the line," he says. "Where do you charge that? The project billing is closed. That cost comes directly out of your overhead. Everyone's paying for that one."

There are some projects where open-cut is a more optimal installation method, Gregor admits, such as jobsites located in more rural areas, ground conditions that would damage equipment or where certain pipe products are used. Projects involving ductile iron or concrete pipe are more likely to be open cut.

One challenge of using trenchless methods, Gregor says, comes from outsiders not understanding the equipment and materials used on a project.

"The biggest thing we struggle with is a lack of knowledge, with engineers or environmentalists, concerning the fluid we use for drilling," he says. "In some areas, it's just water, while other times it's bentonite. What some people don't understand is that bentonite is just clay. They scrape off the ground in Wyoming. The worst grade of bentonite is in cat litter. It's just clay that has been pulverized and put in a bag. Certainly, some companies have made mistakes and filled an area with drilling mud. If you're not getting your returns, you have to stop and figure out where it's going."

Gregor offers some advice to contractors looking to enter the trenchless market.

"If they want to get into this kind of work, they really have to know the costs and risks associated. They also have to have skilled personnel to do the work," he says. "Drilling around utilities without proper knowledge can be deadly. I've seen fiber guys come in and drill without spotting a utility. These guys were hitting gas lines. We had a city in Indiana where they were doing a lot of fiber-to-the-home work, and the gas company there paid Miller to be on site for when they hit a gas line. And they hit a lot. You need to know what the risks are more than anything."

Gregor warns about unsavory individuals in the trenchless industry causing trouble for reputable contractors.

"During the fiber boom, these cowboys went out and bought a drilling machine, and they'd run rampant and they made a lot of messes," he says. "Now, there are a lot of regulations to prevent that, but it can be hard to explain to someone that you are going to do it right."

Companies that don't follow the guidelines and best practices set in place for the industry create future complications in terms of permitting, Gregor says of what he calls "fly by night guys."

As for potential customers, such as municipalities and utility owners that are considering the use of trenchless for new installation projects, Gregor suggests they consult the pros.

"Those engineering departments need to talk to a qualified driller," he says. "A big problem I run into with engineers from municipalities and gas companies is not knowing what directional drilling can and can't do. If they're thinking of installing with directional drilling, they should talk to a qualified drilling company or person, and they can make good suggestions on the type of materials to use and lay it out for them. The drilling company can make it work for them and give an estimate, so they're not sticker shocked when the time comes."

Bradley Kramer is managing editor of *North American Oil & Gas Pipelines* and a contributing editor of *Trenchless Technology*.

HDD *at* 50

Horizontal Directional Drilling Continues to Build on its Prominence and Looks Forward to the Next 50

By Sharon M. Bueno

Horizontal directional drilling — better known as HDD — is now 50 years old. Hard to believe there was a time that such an integral component of the arsenal of trenchless tools was unheard of or not commonly used.

Martin Cherrington — commonly referenced as the Father of HDD — crossed the Pajaro River in northern California in 1971 using HDD without much fanfare. In fact, he didn't think much of his accomplishment at the time. Looking back on this milestone anniversary, he simply says, "Time flies when you're having fun!"

Looking back on this innovative and game-changing construction application, it has been a fun and wild ride. The ride has had starts and stops and we are on a steady and strong path in 2021, with HDD widely accepted as a first option for infrastructure installation.

Once unknown or met with skepticism, HDD today is a multi-billion-dollar, global industry — that continues to grow with each year. HDD encompasses more than just underground infrastructure, including manufacturing, contracting, engineering, and educational sectors, as well. HDD is used to install natural gas, water, wastewater, electric, telecommunication and fiber-optic lines every day across North America and around the world. Once unique to see a directional drill working in your neighborhood, they are now routinely seen drilling in neighborhoods everywhere, leaving behind minimal social, environmental and restorative impacts.

"The adoption of HDD is widespread in a number of industries and being used for things we never dreamed of when we began," says Richard Levings, longtime industry professional and product manager at Ditch Witch and American Augers. "It's the largest percentage of any underground installation method. HDD is used more than any other method. Globally it's a multi-billion-dollar industry, not just in rig sales but in the amount of work that contractors do and the amount of money that HDD saves owners who are installing the networks."

The last 50 years has accumulated so many industry pioneers who have left their mark. Besides Cherrington — who is still active and innovating the industry he created at age 84 — names such as John Mercer, Richard Melsheimer, Gary

Vermeer, Ed Malzahn, Pete Tynes, Frank Canon, John Hair, Ron Haldeman, and Hugh O'Donnell, come to mind, along with many, many others. Each has left their indelible marks on HDD through engineering, manufacturing or contracting.

HDD started off slowly, coming into prominence in the mid-1990s as the telecom/fiber-optic boom propelled HDD into the construction lexicon. New technologies came in rapid fire succession. Construction brands Vermeer, Ditch Witch, and American Augers led the way in rig technology, followed by many others, with a back and forth in upgrades and improvements. Tooling, locating and steering systems, drill pipe and drilling fluid technology all vastly improved at the same time.

In the classrooms and labs, HDD research and education ramped up at the university levels. Design engineers, once slow to adopt the method, began integrating the application in project specifications as acceptance took hold.

"[HDD] is most definitely a maturing industry but it is in no way mature," says Vermeer Industrial Solutions president Doug Hundt, who has been in the industry for 25 years, coming in as HDD just started taking off. "[The market] grew exponentially during those years, about 20 to 50 percent each year. It went from being a novelty and by 2000 when the dot com boom was happening, there were thousands of rigs being produced every year."

The industry started off with shorter lengths and smaller diameters. Today, installation bores are routinely in the thousands of feet, with product diameters upward to 48 in. Intersect HDD applications gave project designers and drillers the capability to more than double the length of projects. One recent intersect bore exceeded 17,000 ft in Hong Kong!

"In the early days, the knowledge wasn't there, the tools weren't there, the experience wasn't there and, quite frankly, there wasn't a lot of trust with the engineers who were designing the infrastructure and that's where it has to start. They have to specify and design the job to be done with a different method," Levings says.

As the Story Goes

Those who live and breathe HDD are familiar with the industry's origins. For those newcomers, here's how it got its start.

In 1971, Martin Cherrington was in Watsonville, California, drilling gas lines for Pacific Gas & Electric (PG&E). While in town, PG&E asked him to take a look at a small problem the utility was facing: how to drill about 500 ft across the Pajaro River to install a 4-in. gas line. Could he drill underneath the river instead of using the more disruptive and costly open-cut method?

Cherrington said the query intrigued him, because at that time nobody had ever attempted that kind of crossing. Initially, he and his Titan Contractors' crew tried to make the crossing using conventional oil field drilling tools. That was a no go and back to the drawing board. This time, he used discarded road boring tools that had a defect to its bottom hole assembly, resulting in the tooling coming up in the middle of roadway. "And that's how we finished the job," Cherrington relates. "We aimed down [into the soil]. There was very little water in the river at the time. First thing that it did was pop up early in the river bottom. We dug a big hole around that exit point, bent the pipe down and pushed it back down into the ground and drilled a little further until it popped up again. We did that three times until we crossed to the other side."

The first crude HDD crossing had been completed about a month after it started. But it made an impression on those who learned about it. An industry was born.

Cherrington's work sparked interest in longer crossings involving pipeline work. Another market came to life during the 1980s that involved shorter, utility installations to replace buried power and cable lines (these lines were installed in the 1960s as part of Lady Bird Johnson's Beautify America program, which among the initiatives, had power and cable lines installed underground vs. overhead).

John Mercer — founder of Digital Control Inc. (DCI) in the mid-1990s — worked for Flow Mole during this important period. The company was researching a way to replace these power and cable lines in areas where easements weren't accessible, and a small footprint was critical. Mercer and Flow Mole created the Guide Drill, a small drill with 1,600 lbs of thrust that used 1-in. drill pipe that could be taken into neighborhoods to install the lines; a cable locator was used to track the underground pipe.

"Our Guide Drill had only 1,600 lbs of thrust, which is laughable these days, and had to be used in softer soils," Mercer says.

Mercer left Flow Mole in 1988, creating his own company with partner Peter Hambling. Together they developed DCI into the industry's premier locating system manufacturer and designer.

From there, HDD began its slow build to where it is today. The first big nudge

came in the early 1990s with gas projects in the Midwest. Established construction manufacturers Ditch Witch and Vermeer stepped into the industry in late 1980s/early 1990s, designing rigs at a record pace as the telecom and fiber-to-the-home boom took off. From there, bigger and better things were ahead.

Research and Education

Research and education are critical to the growth of any industry. HDD is no different. In the early days, both were lacking. When HDD was getting off the ground, Dr. Sam Ariaratnam was a civil engineering faculty member at the University of Alberta in Canada. In 1996 he was first introduced to HDD by a contractor. Twenty-five years later, Ariaratnam remains at the forefront of HDD education, training and research. He joined Arizona State University in 2001, tasked with building its underground utility construction program. He's led the charge to bring the next generation of HDD professionals into the industry, as well as training current HDD professionals.

"Today, we have former graduate students who have become professors who know about HDD and they help impart the word to their students," he says. "It's still the early days of research and it's a relatively blank canvas in terms of there is so much that can be done for HDD. There's a lot [of research] that has been done for HDD and many more things we need to continue to do to keep advancing the engineering aspect of HDD."

Across North America there are student trenchless chapters, exposing the industry to this next generation, and incorporating HDD coursework into engi-

neering and construction programs. The engineering students of 10 to 15 years ago are now leading the way and are HDD veterans.

Ariaratnam notes that education doesn't stop at the university level. Today's HDD professionals seek out comprehensive training courses to increase their knowledge. Courses such as the annual HDD Academy — developed and organized by Benjamin Media Inc. and Ariaratnam — as well as the NASTT HDD Good Practices Guidelines course, provide that needed knowledge. "There is an appetite for formal HDD education," he says. "People come from all over the world to get an education in HDD."

Having engineers already familiar with and comfortable in designing HDD is a huge facet of the industry's growth. That wasn't always the case as the engineering community is a relatively conservative bunch, not willing to jump into new design methods for million-dollar projects without precedent and data that it will be successful, says Bennett Trenchless founder Dr. David Bennett, who was first introduced to HDD in 1991 when he was with the U.S. Army Corps of Engineers and met Dr. Tom Iseley. Iseley proposed that USACE work with him and Louisiana Tech University's Trenchless Technology Center to establish a rehabilitation test facility at Louisiana Tech. Bennett proposed expanding the idea to build large-scale field test facilities for new installation techniques and technologies.

"[Engineers] were slower to come around to HDD than the contractors and manufacturers," Bennett says. "We like to investigate and make sure the claims that are being made are reasonable and that owners and regulatory agencies aren't going to suffer because of overpromising and underdelivering by the industry."

One of the concerns of engineers, as well as regulatory/permitting agencies, involved the possibility of hydrofractures that could lead to adverse environmental consequences. "There weren't any design guidelines or practices to follow," Bennett remembers. "Engineers had very little in the way of design precedence and didn't really even know what the design elements were. In the early years, we didn't have many previous successful projects to rely on for design practice. You had to be conservative and test hypotheses as you went."

He says HDD engineering design practice began to mature in the mid-1990s as more HDD projects and more research projects were completed and reported in the literature. A big step was the development and publication of USACE HDD permitting guidelines, which Bennett and Kimberlie Staheli collaborated on with USACE headquarters staff in the 1990s. Design questions related to hydrofractures, installation loads, pipe stresses, and other concerns were addressed, even if the methods were still a bit crude and field data needed to confirm and refine methods were scarce. Engineers and researchers have now tested theories and calibrated the results against case history observations to a greater extent. Design and construction practice has evolved, partly because we have learned from our mistakes.

In 2001, Bennett and Ariaratnam, with support from NASTT and the industry, collaborated with numerous HDD pioneers from manufacturing, contracting, and suppliers, to write and publish the HDD Good Practices Guidelines, an HDD industry collaborative handbook still in use today. The first edition focused on construction good practices and competent person responsibilities. The Guidelines evolved over the years to include design good practices, and are now in its

Trenchless Technology publisher Bernie Kryzs (left) with Martin Cherrington (center) and Grady Bell.

Cherrington's firsrt HDD rig was built for a river crossing, shown here working on a series of river crossing projects in the 1970s.

fourth edition. The Guidelines have been translated into multiple languages, and brought to light, in an objective way, the various aspects of HDD.

"There has been a lot of trial and error and unfortunately, a lot of errors in the trials," Bennett says. "That's how an industry starts. The first generation of HDD practitioners were flying by the seat of their pants because they simply didn't have the guidance or precedence and had to adapt lessons from oil field drilling, open-cut, and tunneling, etc. to what they were trying to accomplish with HDD. The second generation, which are working today, realized we had to improve design and construction practices and the industry did that."

The third generation is here and making their mark," Bennett says. "This third wave is much larger and smarter, and they're going to make our accomplishments seem rather primitive and crude. They are building and expanding on a solid foundation that past generations established."

Technological Advancements

HDD has come a long way in terms of technology. Better technology has made for a better and more efficient industry. The rigs went from using umbilical technology to being self-contained with rack-and-pinion carriages. Mechanized rod loading sped up the process and was safer, as it removed a person having to manually load the rods. HDD tooling improvements include fluted reamers and better, overall downhole tools.

Cherrington points to the electronic steering system in the late 1970s as the first big technological breakthrough as it gave drillers constant and real-time location of the drilling head. Prior to that the process was done manually using a single shot surveying tool that was also used in the oil patch. The system was slow and time-consuming. "[The electronic steering tool] would tell you where you were and it sped up things enormously," he says.

Mercer notes how much more powerful the rigs are today vs. the early years and how the drill bits are "more aggressive and cut into the soil better." He also notes that the locating systems are more accurate and user-friendly.

Levings says the most impactful advancements over the years have been mechanical, pointing to the rig technology such as the cutting head which went from a high-pressure water tooling to a slant-nose cutting device that allowed for faster and longer boring. He also points to the race between Ditch Witch and Vermeer to come out with newer and better technology. "Competition is healthy and keeps the industry moving forward," Levings says. "The race between these two companies kept these advancements coming."

"There were tremendous improvements in drillhead locating from where it started to where it is today," Hundt says.

"We're able to locate deeper and get more reliable and accurate depth readings."

Impact of HDD

The impact of HDD is enormous and widespread. When you ask those in the industry, they don't mince words about its importance today and in the future. The most common description: Game changer.

"It's just huge," Ariaratnam matter-of-factly says. "Not having to dig up roads and being able to cross bodies of water to install utilities? HDD has incredible environmental benefits."

"For a modern economy, it's absolutely critical to have infrastructure. HDD is the absolute centerpiece and critical technology to make modern infrastructure," Hundt says. "If you think about if HDD hadn't been invented, I don't know if the world would have the same level of broadband capacity we have today. We wouldn't have the same number of pipelines put in the ground. We wouldn't have gas and electric pipes rehabbed to the same level of efficiency they have been. It's an unspoken and unknown thing to a consumer but for those who build infrastructure, own infrastructure and implement improvements in infrastructure, it's been a game-changer."

"We'd have a disaster," Mercer says if HDD had not been invented and open-cut continued to dominate. "All these streets would be torn up; traffic would be at a standstill just about everywhere. HDD is like magic in these areas."

What's Ahead

No one has the proverbial crystal ball to predict the future. But gauging on past and current trends regarding technology and HDD's significance, it's safe to say the application's use is only going to get better, more widely used and more effective.

Does artificial intelligence (AI) have a place in HDD? Experts say yes and research & development have taken deep dives into trying to incorporate AI into HDD. No timetable has been spoken for when or if this will happen.

Operator expertise and equipment will be even more critical than it is today for future HDD projects. "You are going to see precision taken to another level," says Levings. "Because unless they expand the easements you're going to get to the point where there's no room to work. Precision in working in those spaces will be even more important."

HDD for river crossings has advanced since the early years. Here, a rig is shown drilling underwater on a more recent job.

Bennett says we will see a continuation of what we've seen in the industry, only with longer and larger diameter bores being drilled in more challenging conditions. "There will be improved design practices and construction methods to reduce risk and better meet the concerns of regulatory agencies," he says. "I hope we continue to see improvements in pipe materials and in guidance and tracking, which have led to the ability to make these intersects and really long drilling projects possible."

Continued growth around the world is also seen. In countries such as China, India, and Australia, HDD continues to grow while countries in Southeast Asia such The Philippines, Indonesia, Vietnam and Thailand are up and coming hot spots of HDD use, according to Ariaratnam, who has served as chairman of the International Society for Trenchless Technology (ISTT) and continues to travel the world for the industry.

"The global markets will continue to engage in HDD," Ariaratnam says. "There are so many more opportunities for HDD around the world."

And all of this started with one 500 ft crossing in 1971. No one has been more surprised than Cherrington over the globalization of HDD over the last 50 years. To him, that first HDD project was just another job he figured out how to complete.

"It's a funny thing about that. When I finished that first job on the Pajaro River, I didn't think that much about it," Cherrington says. "To me it was just another job. It was a job we didn't make any money on but apparently we made some friends along the way."

And an industry was born.

Sharon M. Bueno is managing editor of *Trenchless Technology*.

Previously published in the April 2021 issue of *Trenchless Technology*.

TRUVAC®

UTILITY LOCATING IS PARAMOUNT IN BOTH OLD AND NEW INFRASTRUCTURE INSTALLATIONS

By Suzanne Penn

HCD cleaning out a horizontal drill exit hole.

Utility locating mitigates the risk of buried utility strikes and strives to ensure the safety of your crew. No two utility locating jobs are ever the same. Whether the job is a new installation, or remediation and repair of existing underground facilities and infrastructure, both require accuracy, safety and visual identification of the underground lines. The TRUVAC® team recently worked alongside local customers and contractors to perform utility locating for both types of underground utility installations using a vacuum excavator.

The first job involved a new installation of a private dedicated underground fiber network in Jefferson County, Colorado. The plan called for a grand total of 300 miles of fiber connecting more than 155 public K-12 schools and one integrated central security center. The 3-year project will encounter all types of challenges as these many locations are linked via new underground cables across a wide variety of terrain and existing structures. A TRUVAC midsize excavator was used to successfully hydroexcavate safely; exposing buried utilities and creating new trenches for the installation of a new underground cable network.

The second job was performed with TRUVAC equipment by HCD Inc., an underground utility contractor in Colorado Springs, Colorado. HCD was contracted to install bore boxes at many locations for the local electrical utility company. Bore boxes are 6 ft by 6 ft by 3 ft, similar to a junction box, these hardened and reinforced plastic boxes have a lid at the surface and are placed in the ground to provide access points to more easily access service in the future. Because these bore boxes will become future points for splicing conduit, each new box was mapped as daylighting was performed with a hydroexcavator. The mapping included both the depth and precise location in order to create a 3D map. The contractor is then required to share these precise locations with the local government that will maintain these maps. This best practice of mapping underground utilities is encouraged, and sometimes required per contract, with the goal of mitigating risk in future underground work.

While both installations described above are vastly different, both include risks of undertaking intrusive ground investigation due to non-existent utility mapping of existing underground infrastructure. The uncertainty of precise locations of existing underground service facilities has led to the advantageous use of air and/or water excavation. Vacuum excavation has become the preferred method to minimize the risk of striking buried services and has earned the industry nickname of "safe digging." The loss of service, costly contamination cleanups, death and serious injury to workers has had an unfortunate upward trend as more utilities are relocated underground. The new materials replacing metal pipes are often plastic and copper cables with fiber optic. These new materials are more difficult to locate, but easier to damage. Using air and/or water to excavate around these utilities provides a higher degree of certainty, safety and efficiency in performing utility location.

Locating buried services is centered around two main stages. The First Stage is always to call 811, the national call-before-you-dig phone number. The 811 One Call

system process should be initiated a few business days before you anticipate beginning work on a project. Once all utilities have responded to your request and all utilities have marked their buried lines, the work site is ready for breaking ground. The marked utility locations are to be used as guides and the crew may begin to dig carefully around any utility marks. Certain situations may warrant consideration of relocating projects that are close to buried utilities.

The Second Stage of utility location begins when the locations are reviewed and the excavation method for either the locating or clearing of the service can be determined.

The method of excavation depends on several different elements, including:

- The type of further geotechnical investigation work scheduled to be undertaken at the site.
- The type of surface cover (e.g., grass, asphalt, concrete).
- The type of soil.
- Available workspace.
- Anticipated density of buried services.

WHY SHOULD I OWN A VACUUM EXCAVATOR?

Vacuum excavation is a non-mechanical and relatively non-destructive excavation technique that uses pressurized water or air, and an industrial strength vacuum to simultaneously excavate and evacuate the soil spoils back into a debris body of the vacuum excavator. This type of excavation offers speed, minimal invasion and minimized damages for borehole applications and trenchless installations.

Slot trenching to find unmarked utilities for future.

Using a high pressure air or water blaster wand to first slice the top ground layer, then break up the underlying compacted soil into loose material, both dry or wet spoils are easily removed using a powerful truck mounted vacuum system. In the case of a hydroexcavator, the underlying soil is combined with water and vacuumed up to create wet spoils. The removal of the excavated material is often referred to as "daylighting" because it provides an unobstructed view and visual confirmation of the location of the buried utility lines below the surface.

Vacuum systems of various types, with vacuum and airflow ratings to most effectively break up and remove soil types such as wet or rocky soil, compacted dirt and clay or loosely compacted soil and sand. Based on different geographies and local soil conditions, there may be other useful options and accessories worth the investment.

Debris bodies of varying volumes and payloads for mid-size to full-size excavations. A larger debris body is designed to maximize dig time and minimize dump time.

Compact hydroexcavator models for tight urban areas requiring maneuverability may be available in non-CDL configurations and offer quick setup allowing operators to flip a single switch to begin operations, greatly reducing set-up and tear-down time.

Additionally, hydroexcavation best practices define pressure limits and the type of nozzle being used, based on excavation depth. New technology is available to prevent water system pressure from exceeding site or industry requirements and effectively take human error out of the equation for increased safety. The Gas Technology Institute (GTI) has been instrumental in establishing and publishing trenchless best practices for damage prevention. GTI supports research and develops new tools and techniques for system installations, repairs and rehabilitation.

HCD locating a gas main for Colorado Springs Utility could pressure test the line.

All these features contribute to increased productivity on the job. The result is smarter digging that will be even more profitable for the contractor.

LESSONS FROM EXPERIENCED CONTRACTORS

Experienced utility locators use several tricks and techniques in the Second Stage of utility location, also commonly referred to as "daylighting." Performing both of the two utility installation jobs in Colorado, described earlier, can provide examples of what experienced utility contractors have come to expect on the job.

1. **Pre-plans Rarely Match Reality:** In Colorado Springs, they were told the existing utilities were at a depth of 35 in. below ground. In reality, these facilities were located at a depth of 84 in.
2. **Expect the Unexpected**: While HCD was performing the job, a gas leak was revealed that needed to be tracked down and repaired before continuing the job. This required finding the main line and leaking connection. Workers entered a gated community and went

Creating an opening for the bore box.

on a search for dead grass, often a telltale sign of a leaking natural gas line below the ground.

3. **Avoiding Debris Spoils with Air Excavation:**
   Often, when the debris body is full, the operator is required to leave the jobsite to be able to dump the spoils at an approved location. Having to dump the debris body offsite will often occur additional expenses and will reduce the overall productivity of the unit. Digging with air allows for the vacuumed-up debris to be dumped on site and used for back-filling if necessary.
4. **Industry Knowledge:**
   Having the right tools with a vacuum excavator can greatly increase overall productivity. TRUVAC has been continuously out in the field with operators to observe different applications so we can learn and pass this knowledge onto others in the industry. Whether it's providing the customer with truck options best suited to tackle any job that may come up, or a need for on the job training, TRUVAC is here to help.

Careful consideration and job practices are required to develop a safe practice to reduce risks inherent in underground utility locating. In all potential utility locating jobs, following the two simple stages outlined above will set the stage for minimizing the risks. The growing popularity of vacuum excavation has shown to be particularly effective in providing the best overall excavation technique when dealing with buried services. Use the tips and tricks shared in this article by contractors on your next utility locating job and benefit from industry colleagues who continue to choose vacuum excavation as the solution to identifying, repairing, and installing underground utilities.

Suzanne Penn is Marketing Manager at TRUVAC.

Fire hydrant was in need of replacement, but the city had no record of the shut off location for the hydrant. Vacuum excavation was used to locate the shut off so the old hydrant could be replaced without turning off water supply to the whole line.

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PRACTICAL APPROACH TO MICROTUNNEL OPERATION

By Jason Holden

For many of us who have dedicated our careers to the trenchless industry, we understand the need for continued education, networking with industry professionals, and sharing our knowledge through seminars and practical manuals. With the microtunneling industry continuing to grow in North America, we have focused much of our attention on general best practices, new technologies and lessons learned on a project scale, while missing a deeper dive discussion regarding the importance of a quality microtunneling operator and crew. These highly trained individuals are oftentimes a key to a successful operation.

If you are engaged in this article, most of you will already understand the microtunneling process and how it works. Instead of focusing on microtunneling systems, I want to focus on some of the aspects that make a great microtunneling team.

MODERN ERA MICROTUNNELING TEAMS

Operating microtunneling systems can feel intimidating to some individuals as remote-controlled operation is performed away from the MTBM equipment. To some, this can feel like trying to fly an airplane by numbers while running the flight control tower at the same time. Operators need to be proficient at multi-tasking and have superb judgement skills in order to react to continually changing scenarios. Some of the best operators have the ability to three-dimensionally visualize the mechanical processes and understand how their inputs will affect the operation based on the geology they are about to encounter along the alignment.

While years of service in the industry can be a valuable asset to help understanding the tunneling process, these individuals may not always have the confidence required for a new environment of remote operations. If I created an ultimate list of skills for an operator, experience would certainly be highlighted; however, other key values such as leadership ability, general electrical and electronics knowledge, computer proficiency, multi-tasking skills and ability to travel for extended periods would also be requirements.

Just like in NASCAR, microtunneling is not an individual sport. We are often posed with the question, "What is the production rate of the system?" While it is often said that NASCAR teams can win or lose a race on pit lane, microtunneling productivity is often highly dictated by the crew's performance. In a perfect world, microtunneling contractors would have a dedicated crew working in harmony with one another to ensure site operations run smoothly and pipe changes are safe and flawless. Unlike NASCAR, where speed is important, microtunneling requires safety and perfection. A microtunneling crew is responsible for ensuring all connections (pipe joints, electric, communications, hydraulic, slurry, etc.) are secure and positioned in a manner to avoid any future issues. Mishandling equipment or not understanding the importance of each component can lead to serious delays or failure along the alignment.

Throughout my time in the industry, there have been a few key topics that continually arise in discussions with colleagues, technicians and customers regarding successful microtunneling operations. This article would not be worthwhile if I didn't share some of these with you.

PREPARATION

If I've heard this statement once, I've heard it a million times: "Do not set yourself up for failure!" Microtunneling is not an industry where you want to intentionally set yourself up behind the eight ball. Preparation prior to a project is a great place to follow industry guidelines and go through mechanical checklists.

- Do not launch your MTBM without a full and complete inspection and pre-launch test to ensure all systems are 100 percent. Some microtunneling systems are too small to access for repair and detailed checklists can help ensure systems are functioning properly.
- Launch the equipment at the proper line and grade. Take time to survey and double check the guidance system set-up with a competent person.
- Inspect the condition and test the slurry separation plant. The slurry separation plant is a key to your project's productivity and a critical part of the system.
- Inform the operator on the geotechnical information, anticipated jacking loads along the alignment, anticipated earth pressures and other necessary information to help them perform their job. The actual ground conditions will dictate the operation of the MTBM. However, the operator must know the anticipated conditions to be more proactive vs. reactive.
- Preset control screen alarm limits. Using the information provided prior to the alignment, each parameter such as jacking tonnage, torque, slurry flow, etc., can have a pre-selected visual alarm set to help the operator minimize distractions.
- Consumables and spare parts. Once a pipe jacking process starts, minimizing downtime is critical.

CONTROLLING THE MTBM

When a MTBM is launched and the machine breaks through the stability of the launch shaft, alignment and control is on the operator. More often than not, the MTBM will tend to deviate downwards and will require

a slight upwards steer to maintain grade. As the machine enters native ground, the operator must undergo what we refer to as a "fact finding mission" for the first several feet. With feedback available from the MTBM, the operator now can determine what inclination at the MTBM is required to operate at the desired grade. Since every diameter MTBM reacts differently with the ground conditions, this must be done at every launch and systematically checked throughout the alignment as the ground conditions change. Once these values are known, the operator can fine-tune the navigation and steering adjustments to minimize deviations.

Steering and alignment control should always be modest and within the designed tolerances. Microtunneling operators must exude patience when the system has deviated slightly and create a plan to correct it over the remainder of the drive length. As humans, we tend to want to quickly correct any mistakes as soon as possible, or in some cases correct them before the next shift gets there so they don't see it. We view a deviation as a mistake, even if it is well within the accepted tolerance of the alignment. Making too aggressive steering corrections to get back to perfect often causes overshooting, leading to further issues such as increase jacking loads, broken pipe or stuck tunnels. Launching the machine on line and grade, knowing the machine's reactivity to the ground, and understanding the tolerances that you can work in allows you to make informed decisions to optimize the performance of the microtunnel system.

ATTENTION AND FOCUS

Modern microtunneling machines and control stations have a plethora of digital and analog feedback available for the operator. A quality operator must know what specific parameters are vital to the operation and adjust the visual alert low/high limits to signal warnings. Much like operating a vehicle, a driver focuses on the road while being cognizant on their speedometer to avoid a ticket or accident. The driver allows the car's check engine light to alert them if something else goes wrong. Similarly, in microtunneling operation, key parameters such as guidance system parameters, torque, slurry system and jacking functions are important, yet the operator can set visual alert indicators on other parameters such

as electrical motor temperature.

Along with digital feedback from the MTBM, microtunneling operators should know the correlation between each system and how one parameter may affect the other. Since microtunneling systems are designed for non-manned entry, additional metering and feedback is designed into each system for redundancy. In the event that a failure occurs, understanding how the system works, where the sensors are located, and why the sensors are installed can help determine the performance of other systems within the machine.

As we mentioned before, operating a microtunneling machine can sometimes feel like flying a plane by numbers while running the flight control tower. It is important that on the jobsite, the microtunneling operator is not being distracted from performing at their best. Far too often I see control rooms filled with additional people such as site inspectors, crew, foreman, engineers, etc., on the job questioning the operation like a backseat driver on the way to Sunday brunch. Control rooms should be for dedicated employees only. All Akkerman microtunneling systems come standard with advance data recording and reporting software, optional external display monitors for on-site personnel and remote-display monitoring that can be accessed at your office. Microtunnel control rooms are intentionally built to limit the number of people inside at one time. If you find yourself on a microtunneling jobsite, please be courteous of this fact before entering.

Slurry microtunneling is still considered an emerging market in North America and is growing every year. Equipment technology continues to advance, and systems become more powerful with each design iteration. Slurry microtunneling operators and support crews are critical to the success of the operation. Advancing the industry not only requires educational efforts for advancing trenchless technologies, but also the personnel that make trenchless possible. We should never underestimate the power of a great operator and supporting microtunneling crew.

Jason Holden is Vice President, Chief Revenue Officer, at Akkerman.

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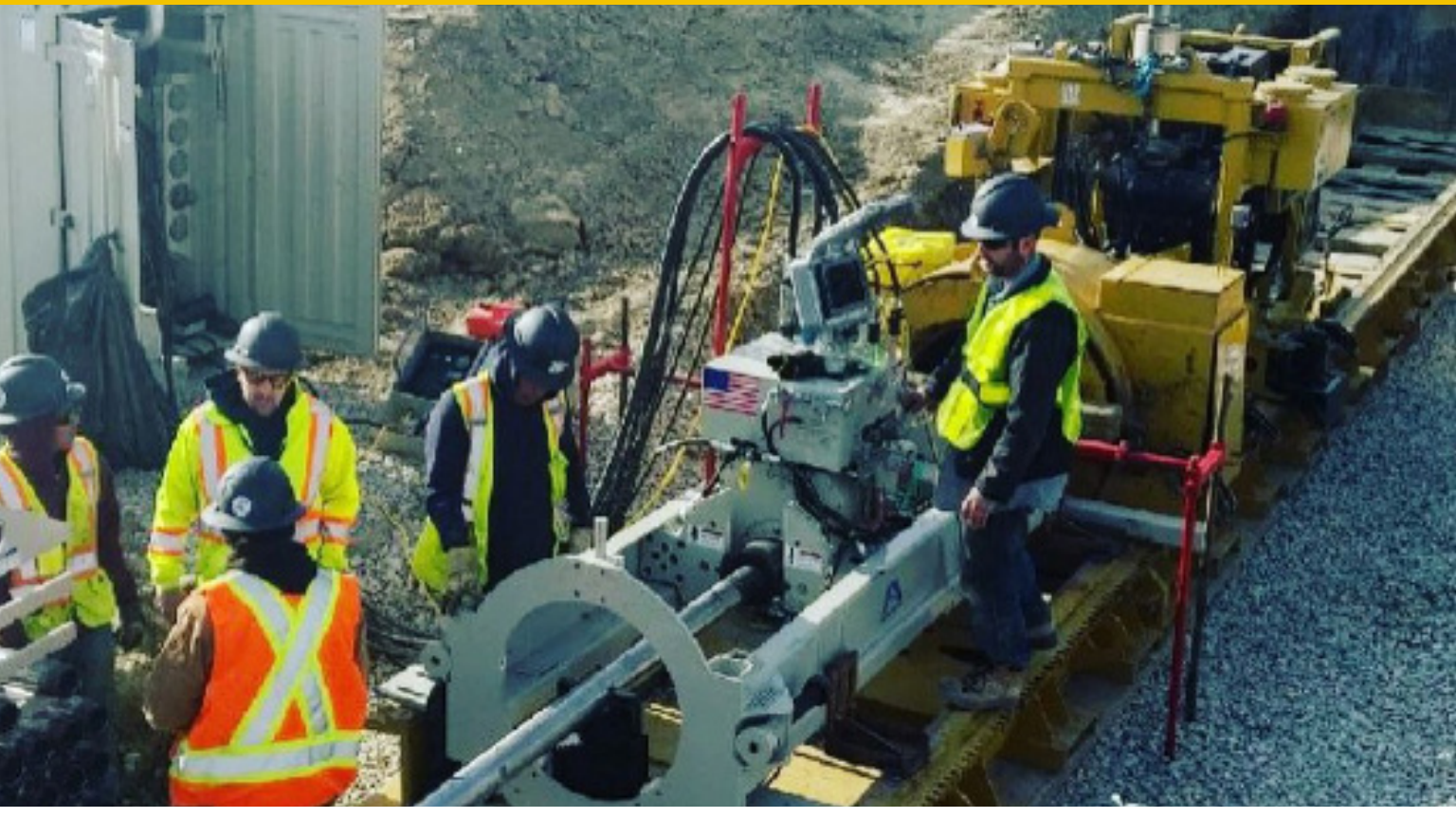
AUGER BORING: THE EARLY YEARS

By Jim Weist



The early years of trenchless installation offered few choices, such as hand mining. Fortunately, a new technology known as auger boring emerged in the early 1900s. Auger boring technology is a simple concept that proved to be very effective for the early adopters. The early auger boring machines used old air motors to rotate small augers to "free bore" (non-cased bores) and then slide the product pipe into the hole. This air power method restricted the bores to smaller sized augers in very good soil conditions. The power restriction led to the development of auger bore machines with gas and diesel power units. The increased power enabled contractors to install not only larger augers but also enabled them to install casing at the same time.

The "new" cased boring method consisted of an auger bore machine and auger inside the casing with a cutting head in front of or just inside the casing. The cased boring method expanded the auger boring market to include different soil conditions. It also proved to be a safer method. With the casing attached to the machine, it greatly reduced the chance of machine rollover often associated with "free boring." The cased boring method soon was the standard and led to the design of larger, more powerful machines. The basic methodology of cased bores continues today, while technological advances and improvements enable contractors to install larger, longer and more accurate line and grade casing installations.

MICHAEL BYRNE MFG. ENTERS THE MARKET

Michael Byrne Mfg. entered the auger bore machine manufacturing market in 1966. Mike Byrne started in a garage in Mansfield, Ohio, making machines ranging in size from 8- to 24-in. diameter. The trenchless market soon demanded larger machines and Michael Byrne Mfg. was at the forefront of developing machines up to 60-in. diameter in the 1970s and early 1980s to meet this demand.

As boring machine sizes increased, so did the support equipment for bore pit set-up and machine mobilization. This proved problematic for the average boring contractor. Byrne solved the problem with a modular machine design that was easy to split into multiple components for a manageable lift. This resulted in easier mobilization and set-up for the contractor.

Larger diameter auger bores quickly identified a weak link in the auger bore machines, specifically the gearbox, which is the core of an auger bore machine. The solution was found with Crichton Mfg. located in Johnstown, Pennsylvania. Crichton was known to produce quality gearboxes with the high torque and compact space required for the auger bore machines. Byrne contracted Crichton to manufacture gearboxes for increased size and torque requirements for larger diameter cased bores. Michael Byrne Mfg. acquired

Crichton in the late 1980s adding customization to the gearbox for the unique auger boring application. While nothing is bullet-proof, the Byrne gearbox with its radial and thrust bearings in the gearbox housing have been the standard for rugged service commonly found in auger boring.

ADVANCES IN TECHNOLOGY

The 1980s and into the early 2000s saw several trenchless methods such as HDD, microtunneling and tunnel bore machines gain popularity and reduce market share from the auger boring method. The demise of the auger boring method proved to be short-lived as many state DOT's, municipalities and most railroads require the auger boring method, due to the stability of the cased boring method. The auger boring method does not use fluids to do the cutting. It relies on the cutting head for excavation, which promotes a stable bore, reducing the possibility of voids along the bore. Auger boring does use fluids for lubricating the casing, cooling the cutting head and cleaning the auger inside the casing, but does not use it for cutting material. Economics also often favor auger boring with many of the other methods costing millions of dollars for larger size bores. The smaller footprint compared to many of the other methods is preferred by customers and stakeholders. Less work area can also lead to cost savings for your project.

Accuracy in auger boring can enable a contractor or engineer to reduce the casing size of the bore saving money on the project. The new line of Michael Byrne Mfg. machines is enhanced with an option to provide hydraulic and electric power to run the Akkerman 240A Guided Bore Machine (GBM). The Akkerman GBM's are the gold standard for precision line and grade pilot bore installations. The Akkerman GBM pilot bores often provide for "gun barrel straight" bores extending distances that have

exceeded 500 ft. The GBM option on the Michael Byrne auger bore machines enables the boring contractor to run the Akkerman system without the need for the Akkerman Power Pack. Contractors realize a substantial cost savings with the GBM option and have no hydraulic lines running down into the pit.

Accessories are available to increase the diameter from the pilot bore using the Michael Byrne boring machines up to 48-in. casing. Swivel cutting heads enable the contractor to follow the pilot bore path in a traditional auger bore method. If an obstruction occurs during the pilot bore path, the auger and cutting head can be removed to see the obstruction and remove it. The cutting head can then be reinstalled to the pilot tubes using a tapered shaft that engages the hex coupling. Weld on reaming heads are also a viable option to enlarge the casing installation in the correct soil conditions.

The new line of Michael Byrne auger boring machines ranging from D42-950 to D84-1.9 now employ several enhanced safety features and are CE certified for exporting to countries around the world. Safety features include:

- Emergency stops located around all parts of the machine.
- Redundant rollover tilt switches to disengage power if the machine tilts past 5 degrees.
- Visible and audible machine movement alerts.
- Remote control operation of the machine with an HBC remote control that can be used wirelessly or with a tether switch. The remote provides the operator operational information needed including Engine & Auger RPM, Temperatures, Fuel Level, DEF levels, Hydraulic Pressure, dog alignment in tracks, clutch engage and disengage, e-stop, lights, cylinder thrust, GBM operation only, and setting maximum hydraulic pressure to be used (see photo below).
- Tier 4 compliant

Michael Byrne Mfg. augers are designed to withstand the longer and larger diameter bores with class leading wall thickness for 3-, 4- and 5-in. hex auger tube. Michael Byrne cutting heads are designed for the extreme conditions encountered in trenchless applications with high-strength carbon steel bases and reinforced holders and cutting teeth. In 2013, Michael Byrne Mfg. was approached by several contractors requesting HDD parts and supplies for various HDD rigs because of our rugged product designs and our personalized service and follow up. Today, Michael Byrne Mfg. carries numerous HDD products in stock providing our customers another supply chain option with a proven vendor.

Michael Byrne Mfg. continues Mike Byrne's mission to provide industry-leading power and performance auger boring equipment and unparalleled service and support after the sale. The complete line of Michael Byrne products is available to view on our website *byrnegroup.com* or call 419- 525-1214 to speak with one of experienced sales representatives.

Jim Weist is President of Michael Byrne Mfg.

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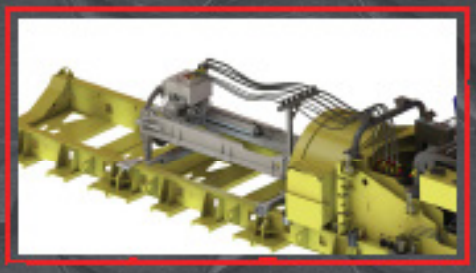

- Best-in-class torque and thrust performance
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DIRECT PULLBACK WITH SMALLER DIAMETER BORES

By Peter Melsheimer

Horizontal directional drilling (HDD) involves some very complex operations to successfully complete a typical job. Creating a pilot bore, pre-reaming that bore and performing pullback operations typically make up the complete process.

HDD pipe pullback might be the most important step of the process since it involves installing the pipe as intended to complete the project and can be a hingepoint in the job for something going awry. Using a "pullback device" is a method selected by many drillers for the following reasons:

1. The outcome of the project hinges on proper pipe installation and can be costly if done wrong.
2. Improper pullback can damage existing pipelines.
3. Mistakes and inefficiency will cost you time and money.

As a driller or contractor, planning is crucial — especially if you want to be efficient. There are a lot of factors that go into pullback, along with notable risks, and considering all of them will help you select the right product pipe and drilling rig. Having an effective HDD pullback device will make planning and operation a bit easier so you can get the job done. In the recent economic climate of COVID-19, while internet demand has skyrocketed, residential telecom and fiber-optic work has become crucial. Contractors that frequently work in residential areas know that these tight conditions often accompany

jobs where other buried utility lines are everywhere.

For all these reasons, direct pullback is fast becoming a standard for jobs up to 12 in. in diameter since it is faster, easier and saves time by never removing the drillhead. The FastBack System from Melfred Borzall is a revolutionary pullback solution that works like a charm in dirt, sand, clay and hard, compact soil.

Melfred Borzall's FastBack System is a family of HDD pullback devices that allow you to ream up to a 12-in. hole without taking the drill head off. You just attach the cutter blocks and pullback device. But fast means nothing without accuracy, and FastBack devices are primed for both. In addition to being quicker and easier, the system also offers drillers a safer way to manage equipment and get their job done. A FastBack direct pullback system consists of the following components:

FASTBACK PULLBACK ATTACHMENTS

Since you don't have to remove the drill head to install a reamer, FastBack pullback attachments allow you to perform HDD pipe pullback soon after completing the pilot bore. These pullback tools attach directly to your bit or blade and are designed to hold an MBI swivel in line with the rotation.

FASTREAM ENABLE SD HOUSING

When access to the exit side is restricted, FastReam SD housings provide direct pullback for a large pipe or a group of pipes. It effectively turns a transmitter housing into a backreamer. The new SD Housing has the added Pit Bull Blade-locking design feature and integrated MudBoost port to help with direct pullback.

FASTBACK CUTTER BLOCKS

Working with SD Housings, these cutter blocks transform the SD Housing into a reamer, cutting up to a 12-in. diameter. The design is based on our most versatile reamer, The Tornado, which provides great pumping and mixing action — and gets through the toughest conditions. FastReam cutter blocks only require small tools for installation, such as Allen wrenches.

FastBack direct pullback system makes it so you don't have to haul a ton of equipment into a large pit just to install a reamer for HDD pipe pullback operations. This cuts down on time, environmental impact and safety risks. The system's ease of use dramatically increases efficiency and accuracy as well, limiting the potential for mistakes and damage — and maximizing profits in the process.

While the ability to ream only up to a 12-in. hole isn't right for every job, it's perfect for installing service lines to homes and businesses or any job that involves pulling fiber. Since you don't have to take off the drill head, you'll be able to do it fast.

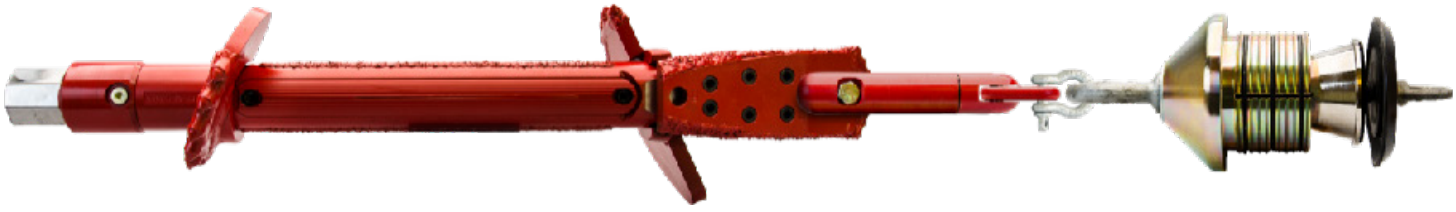
FASTBACK DIRECT PULLBACK TO THE TEST

Putting the FastBack System to the test, Melfred Borzall had a customer that was a large gas distribution contractor who was facing a tough challenge: they had a short bore job that required crossing six different utilities.

This 120-ft bore to install a 3-in. polyethylene gas main meant weaving through one 6-in. high pressure gas main, one 6-in. low pressure cast iron gas main, one 6-in. water main and three communications lines. It was a three-dimensional puzzle buried in the ground.

Though the red clay soil made for relatively easy drilling, this job required precision and careful attention. There was no room for error. The foreman instructed his teams to carefully open up the areas where the utilities were located. Upon inspection, the superintendent insisted that the crew repeat the process to deepen the pits and expose more of the lines. It was a wise choice. Even with advanced equipment, setting up the worksite thoughtfully makes it easier to manage tools during drilling.

The pilot bore went smoothly.



Once at the receiving pit, the directional housing had two FastReam Cutter Blocks installed. Two of the MudBoost fluid ports were opened up to supply more fluid during the reaming and pullback. A QuickSwivel was bolted to the blade and the 3-in. polyethylene pipe was attached. The two FastReam Cutter Blocks make a great backreamer for soft to medium-hard soils. But another advantage is that there are only two blades spaced apart and offset 180 degrees from one another. Because of this, the operator was able to carefully adjust the position of the blades to avoid a strike on one of the existing utilities while crossing. This was the perfect set-up for a job of this complexity. FastBack reamers are inspired by the design of our Terminator-style reamer,

which was originally developed for drilling clay. It's an efficient cutter in soft to medium soils — but its advantage is that it only has two blades. Because of this, the operator can carefully adjust the position of the blades to avoid a strike on a line. Our pullback got off to a great start. Everything was going beautifully. And then we reached the utilities.

When we got to the exposed pipes in each pit, we stopped the job to assess the situation. This is where we had to be very careful. But the FastBack System was up to the job. We pulled one blade over, then rotated 180 degrees. Then we pulled the other blade over. With a normal reamer, this action is impossible because the blades are positioned too close. But the FastBack design is primed for this type of accuracy. We were able to lace the pipe through while maintaining enough clearance from all other lines. Before we began, the crew was skeptical. Why not just trench the job? they asked. There was the inevitable grumbling that comes with trying something new.

After we finished, however, the crew was blown away with the amount of time it saved. With a full trench, this job would have taken at least two days for trenching, install and backfill. With the FastBack System, the whole job was completed in a single day. The drilling only took a couple of hours. The majority of the time was spent manually hollowing out the areas surrounding the existing lines. The amount of time the contractor saved was enough to convince the company to invest in several additional FastBack Systems to put to work in other scenarios.

Melfred Borzall's FastBack System was the perfect solution to a complicated job like this one. But our original impetus to develop this groundbreaking (no pun intended) tooling was to make drillers safer and more efficient.

The FastBack System reduces the need to haul a breakout system down into the pit to install the reamer. Now crews can simply install FastReam cutter blocks directly to the housing by using a set of Allen wrenches and other small tools. Cleaning the housing and installing the cutter blocks can be completed in a few minutes. The result is safer, quicker and easier to manage equipment that helps drillers get the job done better.

Peter Melsheimer is Vice President of Sales & Marketing at Melfred Borzall.

"Since the 1940's, we have worked side-by-side with utility contractors singularly focused on making utility installations more productive. Through our unwavering commitment to innovation, production of American made best-in-class HDD tools, and providing unparalleled support, we have thrived in an industry we love for the past 75 years. Thank you to all the drillers, our distributors, and our family of employees that have helped steer our business and products in the best direction."

- Dick, Eric, & Peter Melsheimer
Owners, Melfred Borzall

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Tunnel Construction Manager.
Northeast Ohio Regional Sewer District

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Donald Del Nero, PE, CDT
Vice President/Global Tunnel Director Hatch

"*Trenchless Technology* magazine has been a mainstay of the trenchless industry for decades. It is the place you come to find the latest and greatest in the industry, to understand how trenchless is being applied to solve infrastructure problems and participate in the trenchless community."

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