Tech Perspective

Pull or Punch?

Static and pneumatic pipe bursting each have benefits for specific applications. Savvy pipe repair contractors take time to learn the difference.

By John Rafferty

Tech Perspective looks at technology-related issues and provides information and advice that cleaning professionals can apply to equipment selection and to their daily work in the field. Industry members are welcome to offer ideas for this column. Please direct them to editor Ted J. Rulseh, editor@cleaner.com.

Every major industry produces specialized segments, each with its own vocabulary of technical terms. In the construction business, some terms communicate beyond their professional audience, while others are more mysterious.

In underground pipe installation and replacement, the relatively recent word "trenchless" seems clear and unequivocal, even to the uninitiated. Yet choosing which method to use can lead to confusion, even among contractors.

For example, when pipe bursting to replace existing utility lines (and to a lesser extent to install new ones), professionals talk about using either static force or impact force. Both methods use a mole, or bursting head, attached to a cable inserted into the old line. (Steel rods and chains are also used for static bursting.)

The mole is a steel cone that is pulled through the old pipe, shattering it and expanding the earth while simultaneously pulling in new pipe. In some cases, there can be a series of two or more moles, graduating upward in size to the desired diameter. Moles can be short and simple, or they can be long and elaborate with rolling blades and sharp fins, depending on the host pipe material and the chosen bursting method.

Hitting resistance

Naturally, the amount of force required to burst is directly related to the resistance encountered by the mole and its passenger pipeline on the journey from entrance pit to exit pit. That resistance is broadly comprised of existing ground and host pipe conditions, plus the diameter and length of the introduced head and new pipe assembly. New pipe can be the same size as the host pipe or larger in diameter.

Ground conditions include soil compaction and composition, moisture content, and natural or manufactured obstacles, such as large tree roots or rocks, concrete pours, foundations, and other utilities or structural elements. Host pipe conditions include the diameter and type of material to burst, the length of the line to replace, couplings and connections, plus any mechanical bends in the line (such as those found in sewer laterals).

Different strokes

A static burst relies on pull alone, so that resistance against the mole and new pipe assembly is overcome by brute force applied to the cable (or equivalent), stabilized on the pulling end so that the mole moves rather than the puller. An impact burst uses percussive force, typically combining heavy hammers guided by relatively light cables pulled by a constant-tension winch. (There can be variations on this theme, mixing diverse machinery with different combinations of static and impact force.)

A 12-inch impact unit, for example, might have a hammer assembly weighing hundreds of pounds inside a large terrestrial torpedo whose gross weight is well over half a ton. Such a beast might be attached to a 5/8-inch cable, while only four or five tons of pull is applied by a constant-tension winch. In this case, however, the impact leader is just a persuasive guide — like a dog's leash — rather than the prime motivator. The relatively small load on such a pneumatic assist cable allows it to be far thinner and lighter than what is needed to burst the same size pipe statically.

By contrast, a 12-inch static burst might employ a 1 1/4-inch compact swaged cable weighing three or four times as much per foot as that used to tow a 12-inch impact mole.

A 60-ton static puller uses 1-inch cable to burst an 8-inch clay sewer main. (Photos courtesy of TRIC Tools Inc.)

But if cable size and weight are lower for pneumatic bursting heads, the impact moles themselves are considerably longer and heavier, since they must contain an internal hammer with enough mass and travel to literally pound the head through the ground, like a horizontal pile driver. The largest pneumatic units can weigh many tons, requiring multiple high-volume compressors to operate. Some impact units are reversible, capable of backing out of the new pipe after the burst is complete. As with all pneumatic bursting heads, at least one air hose runs inside the length of the new pipe from the impact unit to the compressor.

On the other hand, the static mole only has to be strong and hard enough to resist the friction and pressure of expanding the surrounding earth and breaking through pipe, joints, and couplings. Consequently, a static head can be significantly lighter and more compact than its pneumatic counterpart, even when it has special cutting blades and rollers.

Static force is more prevalent when defeating steel and plastic pipes that split rather than shatter, because a steady pull with blades is less likely to compact or "bunch up" such material.

Universal law

Regardless of method, a universal law applies: Every action has an equal and opposite reaction. A steel bursting head moves through the ground and drags pipe behind it in reaction to the specific directional force applied to it, be it percussion

from within or tugging from the outside. The objective is to get new pipe in the ground, yet the logistics can vary, depending on what force is used.

Whatever the force, if well applied, the end result is time (and materials) saved on the job. The bigger the job, the more critical are the logistics. The contractor's best bet is to understand how different methods apply to specific job scenarios.

Static machines are either rod pullers or rope pullers. Rod pullers are used for utility line and sewer rehabilitation in the municipal market, from smaller service lines to medium-large sewer mains. Rod systems are suitable for straight runs of all types of service pipe material. They are self-contained frame or box units with hydraulically or mechanically actuated grippers that both push and pull steel rods, each averaging a couple of inches thick and a few feet in length.

Rods are threaded together during the "payout" (pushing) phase and fed into the host line from exit to entry pit. This "rod-train" has a certain degree of flexibility to negotiate sweeping bends. During the pullback (bursting) phase, the rods are unthreaded one at a time as they exit the machine. Larger machines have rod storage bays, are hydraulically self-adjusting and stabilizing in the exit pit, and power-spin the rods during assembly and disassembly phases. Rod pullers are not designed for operation in confined spaces.

If rod pullers are horizontally configured, then rope pullers are essentially vertical. Most rope pullers have some version of a reciprocating gripper system set between hydraulic rams, which are often mounted on a pulley apparatus so as to cycle upward, making the system more intrinsically compact, and therefore more adaptable to confined spaces.

This feature, combined with shorter and more agile static moles, gives rope pullers a strategic edge over impactors when bursting small to mid-sized lines in easements (especially sewer laterals with mechanical bends).

Rope pullers use either a cable or a chain, which must be fed into the host pipe between entry and exit pits. This is a separate operation (also required for pneumatic assist cables) that might employ a fiberglass duct rod for short to medium runs in smaller pipe. For larger, longer runs, a hydrojetter is often used to navigate the host line and pull back a nylon rope or small towing cable to attach to the pulling cable (which can weigh upwards of 10 pounds per foot for the largest static machines).

While chains won't fray or kink, and have positive link engagement to grippers, cables are more widely used and have a greater strength-to-weight ratio. Cable is the standard for the majority of rope pullers, from the earliest lateral bursting systems using modified post-tensioning rams to the custom 300-ton goliaths pulling 2 1/4-inch cable and 36-inch sewer mains.

Going pneumatic

Regardless of method, a universal law applies: Every action has an equal and opposite reaction. A steel bursting head moves through the ground and drags pipe behind it in reaction to the specific directional force applied to it, be it percussion from within or tugging from the outside. The objective is to get new pipe in the ground, yet the logistics can vary depending on what force is used.

A static lateral bursting system pulls a 4-inch sewer into a basement.

Pneumatic pipe bursting is by far the most common method worldwide for trenchless replacement of municipal pipelines. It has produced the largest-diameter moles and expanders, as well as the greatest variety of mole combinations within a given diameter. With impact bursting, the heavy artillery is in the ground, and special equipment is stationed at both entry and exit areas (compressor and winch).

Entry pits are longer in general, but not always. The pneumatic recipe requires low static force at the exit pit, allowing in some cases a smaller and less intrusive winch extension inside confined areas such as manholes and catch basins. The other side of the equation is accommodating the big missile when it finally arrives at its destination.

In some cases the hammer unit is reversed; in other cases it must escape to the surface via a separate pilot bore. Also, one troublesome condition exacerbated by impact bursting is wet, sandy soil that closes back in on the trailing new pipe, creating extreme drag. The same pull with a comparable static system would likely go more quickly.

Bentonite solutions are particularly recommended for impact bursting in these situations. A special manifold is inserted in a window cut out of the new pipe near the bursting head before beginning the burst. The solution is then mixed onsite and pumped as needed through a supply hose inside the new pipe during the burst.

A natural advantage to static bursting, even if used infrequently, is the ability to fuse pipe progressively while pulling, since there are no air hoses inside the new pipe to interfere with the fusion process. This advantage becomes more evident with larger municipal pipelines in difficult landscaping situations.

There are countless scenarios surrounding municipal infrastructure rehabilitation. The good news is that there is often a clear choice between digging and not digging. No project is 100 percent predictable, and underground projects are certainly among the least predictable of all. If pipe bursting is an option, then knowing the questions to ask regarding each method can mean the difference between a hard-earned lesson and well-earned cash.

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