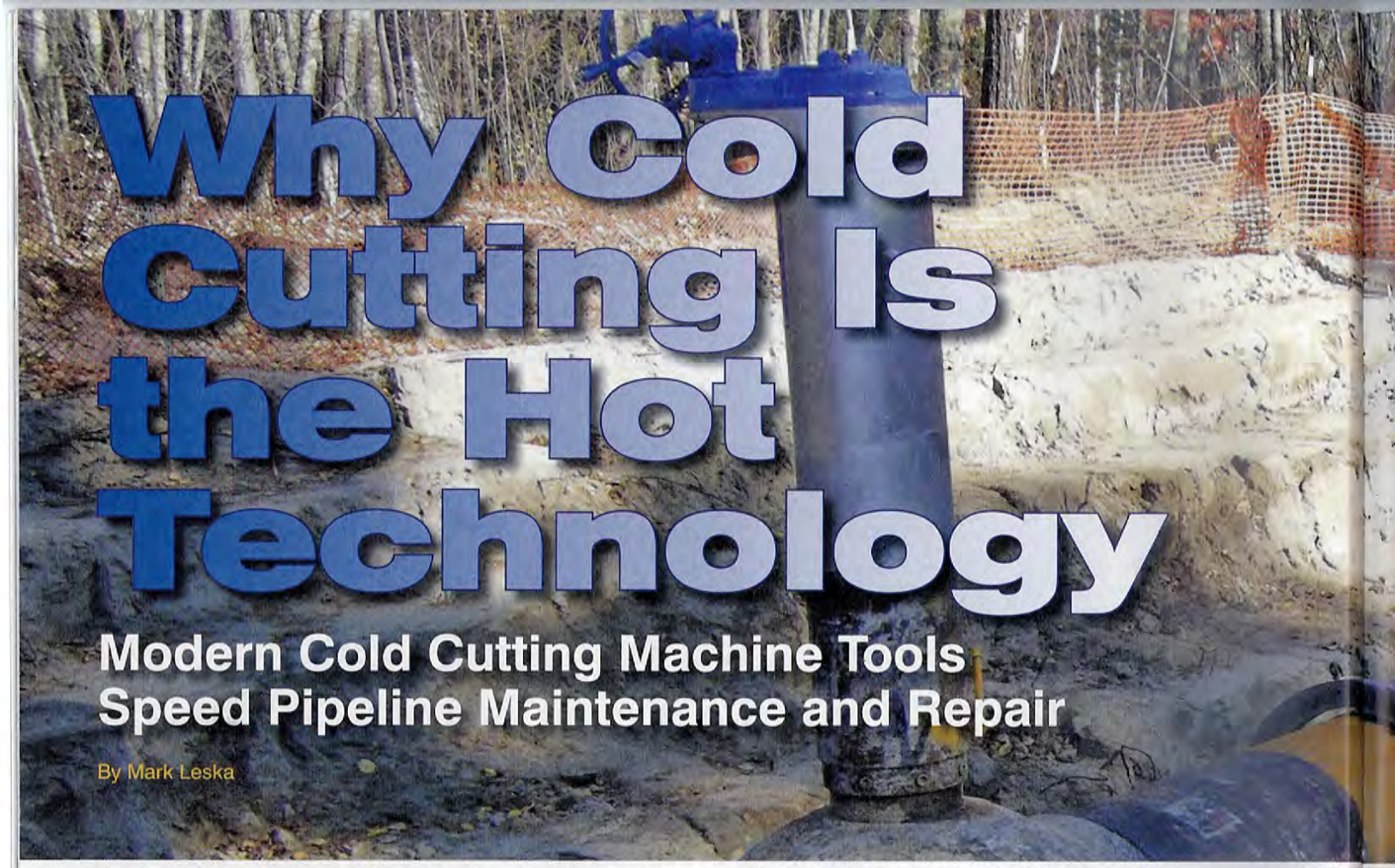

Why Cold Cutting Is the Hot Technology

Modern Cold Cutting Machine Tools Speed Pipeline Maintenance and Repair

By Mark Leska

North America's pipeline distribution network is a valuable infrastructure that, in a true case of out of sight and out of mind, is often out of the public consciousness. This vast network, estimated at more than 2.5 million miles in the United States alone, safely transports natural gas, liquid gas, petroleum and petrochemical products for the benefit of our modern society. More than 3,000 companies, both large and small, own and operate this network.

The common element often present in pipelines is hydrocarbons, the basic building block of energy products. While pipeline operations enjoy a strong safety record, the presence of hydrocarbons makes for a potentially hazardous situation when pipeline repairs, modifications or decommissioning are needed. A series of significant and serious incidents in past years, while tragic, have contributed to the development of a series of "best practices" designed to advance pipeline repair safety.

Key to these practices is the use of "cold cutting" machine tools, designed to cut pipe without the use of the "hot cutting" employed in years past. Hot cutting uses a torch (with its open flame) to cut the pipe, then requires a second step of hand grinding to create a suitable weld ready surface. This process required the difficult, laborious and time consuming process of evacuating and "inerting" the pipeline, typically with nitrogen gas, to prevent combustion.

In 1949, following input from natural gas utilities, the first generation of cold cutting machines was introduced, named the Trav-L-Cutter. This device revolutionized pipe cutting, and today is used in every corner of the globe. Designed to crawl around the pipe on its mounting chain, it utilized a high speed milling head to simultaneously cut the pipe and bevel it. Eliminating the flame was an obvious safety benefit, but just as important was the precision beveled surface created, ready for welding.

Unlike ordinary household tubing with couplers and square cuts, industrial pipelines require a bevel prior to being joined. Beveling is the process of removing material at an angle away from the cut, typically at 37.5 degrees, to create an included area of 75 degrees for the welding root pass and filler material. This process of collectively cutting and beveling is called "weld prep" and is required before pipeline sections can be welded together. With the proper weld prep and a skilled welder, the ensuing welded connection is as strong as or stronger than the parent pipe material.

The first generation of cold cutting machine tools set the priority for pipeline repairs that remains true to this day, and is the driver for best practices. In order they are: 1) safety, 2) time and 3) money. Safety is first and foremost, and is the primary consideration before any pipeline project is planned. The current generation of cold cutting machine tools is designed to eliminate the hazards associated with thermal cutting and increasingly is being specified for its inherent safety advantages. For example, in Central and South America the larger state-owned petroleum companies have taken the lead in specifying that only current cold cutting machine technology be used anywhere on their infrastructure where hydrocarbons exist.

Another significant advantage to the machining or cold cutting process over thermal is preventing the creation of a HAZ, or Heat Affected Zone. Applying extreme temperature to a pipe, such as produced by plasma or acetylene torches, changes the molecular structure of the metal itself, often altering its properties to detrimental effect.

Time and money go hand-in-hand when it comes to modern pipeline operations. Due to the tremendous volumes now being carried in the pipeline infrastructure, any disruption tends to have outsized cost implications.

Typical pipeline repair showing line stopping, evacuation connections and cold cutting split frame machine tool in place.

Time is also of the essence in regards to environmental concerns, where recent events demonstrate that faster is better to stop or prevent leaks and spills that damage the environment. Therefore, within the confines of the safety paradigm, any tool that can perform its task faster is, by its very nature, better.

The "best practices" for pipeline repair have evolved to reflect advances in the machines used. A typical line repair where a component or section of pipeline requires replacement involves four basic steps: 1) line stopping, 2) evacuation of product from the isolated section, 3) cutting the defective section out and 4) welding the replacement section in place. While this is an oversimplification of a complex task, it gives an indication of the machines involved in modern pipeline repair.

Line stopping refers to stopping the product flow upstream and downstream of the repair via line stop and hot tap devices. Starting with a split tee affixed to the pipe, a window is cut and a plug inserted to stop the flow of product. In step 2, the product is evacuated in the isolated section via hoses and pressure or vacuum. Step 3 is cutting the section out, using modern cold cutting machine tools, and step 4 is the actual pipe replacement.

The modern cold cutting machine tool specified by most pipeliners today is the rotating ring pipe cutter known as the split frame, or in some quarters as a "clamshell." Split frames are named for their ability to split in half at the circular frame, or "break open" and bolt back together again. This allows them to open and mount around the outer diameter of inline pipe. Split frames come in various configurations, such as low clearance models designed to balance weight, clearance and portability issues, and heavy duty models designed for large diameter or heavy wall pipe.

Low clearance split frame shown after making the "money cut." The LCSF is part of a complete machining system ideal for pipeline repair.

Available in pneumatic or hydraulic drive models, the modern split frame is the basis of a complete machining system. Machine accessories, including tool slides (that hold the tooling) and tooling (cutting bits), are available to cut, bevel, counterbore (machine the inside of the pipe) and face flanges. The best machines are able to tackle just about any onsite machining project likely to be encountered in the field.

Like the milling machines, the split frames are able to cut and bevel simultaneously. They're capable of machining much faster than the milling process allows, and with a higher degree of accuracy. And unlike thermal cutting and grinding, only machining allows you to produce the compound bevels and complex "J" prep specified by leading welding equipment manufacturers.

Weld prep machine tools like the split frame are designed to set up quickly, to cut quickly and to cut and bevel with great precision. Destructive cutting is easy no matter the tool used, but what really counts is the critical cut needed for fit up, dubbed the "money cut." It's the cut that must be exactly correct, and only the split frame will cut with the accuracy to deliver the goods, time in and time out. Portable weld prep machine tools are designed to produce square cuts for an accurate root pass, to ensure a quality weld, great repeatability and a level of workmanship that virtually eliminates reworks.

Different kinds of weld preps make for different challenges. Working in oil and petrochemical plants can mean extremely tight clearances, where it can be difficult to fit an arm between two pipes let alone a cutting machine tool. Pipelines pose their own unique set of challenges for maintenance professionals in the industry.

Apart from the physical demands – repairs always seem to be needed in the middle of nowhere – pipelines often use medium to large diameter pipe with relatively thin walls of about 0.5 in. (12.7 mm) or less. While thin wall pipe sounds like an easy task for the machinist, this type of pipe is seldom perfectly round, and may be somewhat egg shaped, a condition known as "out-of-round." To counter this condition spring tracking or out-of-round (tool) slides are available. They use springs to locate a wheel that rides along the contour of the pipe, preventing the tooling from diving in and out of the work.

Tracking slides allow the creation of a uniform land, which is that portion of the weld prep that accepts the critical weld root pass. The land is the most important part of the prep. If the land is too narrow, then the welder may burn a hole through it. If the land is too thick, then there may not be proper penetration to the base metal. Out-of-round slides also speed the set up of the machine, making it less critical that the machine is perfectly centered on the pipe. This is a very useful attribute on both out-of-round and round pipe.

The bottom line is safe, accurate and cost-effective cold cutting machine tool technology continues to advance, allowing the professionals using these products to realize great strides in safety, decreases in downtime and overall savings in repair costs. The pioneering manufacturers that built the first generation machine tools remain committed to engineering the best tools for pipeliners, so they can continue to make pipeline infrastructure one of the safest ways to transport the necessary products that run our daily lives.

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