Cold Cutting: A Clean and Repeatable Technology

Portable machine tools for cold cutting have many advantages for end prepping pipe prior to welding

BY MARK LESKA

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For pipe cutting or weld preparation tasks related to maintenance or new construction, there are primarily two different methods commonly used. The first is heat (thermal) cutting with subsequent hand grinding, and the second is portable machining, popularly known as cold cutting, which produces a weld ready surface — Fig. 1.

Reasons to Choose Cold Cutting

While each has its adherents, cold cutting and beveling is considered by many a superior method due to its precision and inherent safety advantages. Machining eliminates the risks associated with open flame torch cutting, particularly important wherever volatile hydrocarbons are present. The cold cutting method also eliminates the undesirable heat-affected zone (HAZ) created by thermal cutting, altering the molecular structure of the metal. Due to these factors, more industries are specifying cold cutting as part of their project bid process.

Cold cutting in its simplest terms uses a portable machine tool to cut or prep prior to welding or flange assembly. Weld prep can take multiple forms: beveling, compound beveling (with two or more bevel angles), J prep, counterboring (machining the inside of the pipe), facing (machining a square edge), and flange facing (machining the mating surfaces of bolted flanges) — Fig. 2.

Form Tooling vs. Single Pointing

There are two basic types of portable machining, form tooling and single pointing. Form tooling uses shaped tooling (or cutting bits) to create the final contour or profile of the finished prep. It tends to pull larger chips and requires additional machine rigidity and power than single pointing. The benefits of form tooling are it can be faster than single pointing and may be easier to set up and operate for a less experienced operator — Fig. 3.

Single pointing refers to machining, using the point of the tooling to take a fine cut and pull a smaller chip. The ben-

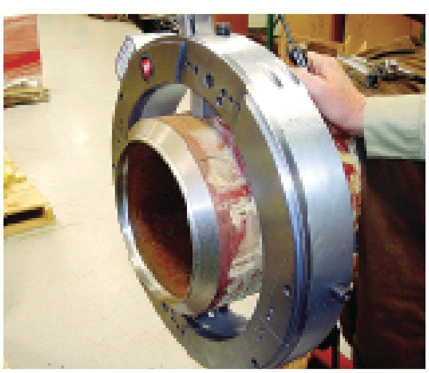

Fig. 1 — Cold cutting produces a precise, repeatable weld ready finish in a single step.

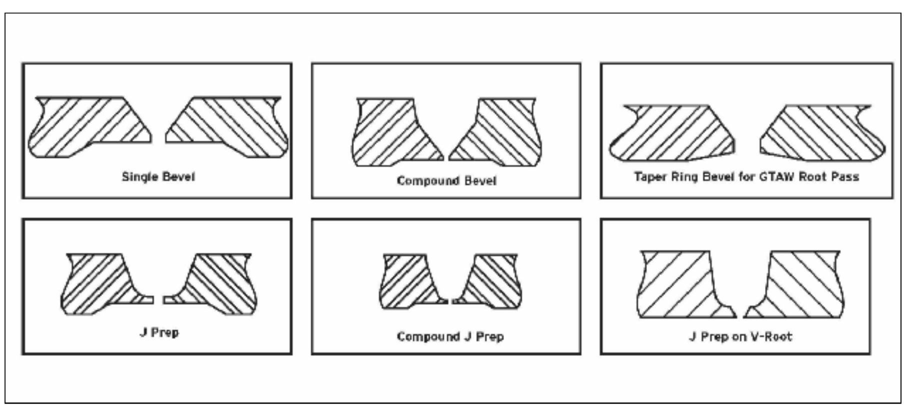

Fig. 2 — Typical weld preparation profiles. Many profiles are only achievable by machining.

Fig. 3 — Form tooling offers ease of setup and operation.

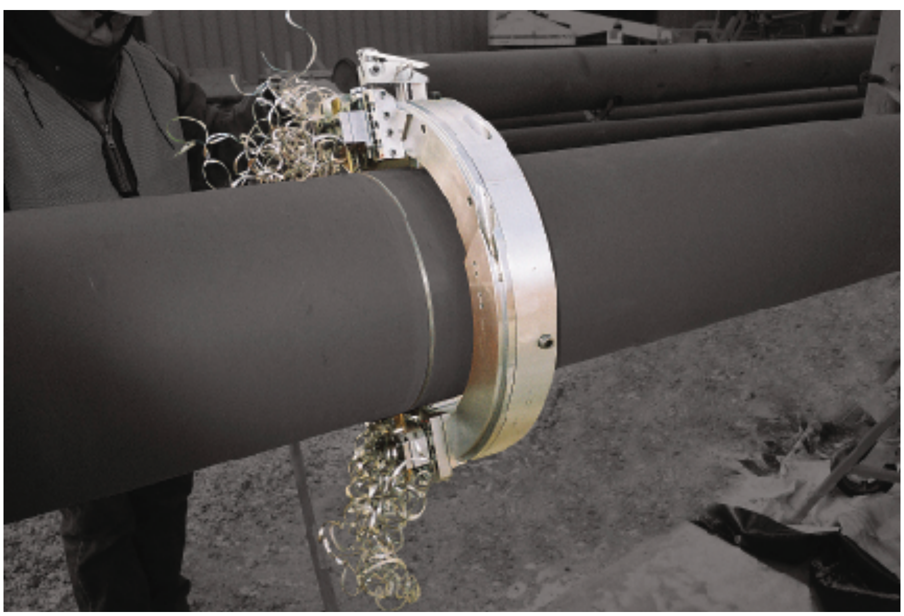

Fig. 4 — Versatile split frame machining systems utilize lathe technology to deliver perfect preps.

efits of single pointing are the ability to machine heavy wall or high-alloy material that tens to resist form tooling, and the versatility of creating custom profiles. Another benefit is the choice of using a machine tool with a smaller power requirement.

In addition, single point cutting bits are generally less expensive than form tooling cutting bits. They are often available as an insert bit and holder arrangement, with multiple cutting points offering a lower cost per cut. By its nature, single point machining tends to have longer cut times than form tooling, and in certain instances may require set up calculations by the operator to successfully create the final prep.

Machining Technologies

Machining produces the consistent, repeatable weld preps needed to ensure weld integrity, critical to timely and profitable project outcomes. Machining in general utilizes a wide range of technologies to accomplish various tasks. These machining technologies include lathe, milling, reciprocating, abrasive, chipless cutting, drilling, and threading. No single technology is best for all applications, with some projects or tasks employing multiple technologies. Portable machining also offers the ability to apply various remote control and automation schemes where required.

Lathe

Lathe machining offers great accuracy and repeatability by utilizing a rigid, rotating frame with fixed tooling. Lathe cutting and beveling is used where a project requires 360-deg machining of objects such as tube, pipe, vessels, cylinders, and conical objects. Lathe cutting produces a finish that in years past was only achievable in a well equipped machine shop. The best known pipe-cutting machine tool using lathe technology is the split frame, a rotating ring pipe cutter and beveler named for its ability to “split” in half for mounting to inline pipe.

Machining with a split frame (which may also be referred to as a "clamshell") is highly versatile. Properly configured, it can be used for cutting, beveling, compound beveling , counterboring, facing (or squaring), and flange facing. With its comprehensive group of accessories, the split frame becomes a complete, integrated machining system that can tackle most field machining tasks — Fig. 4.

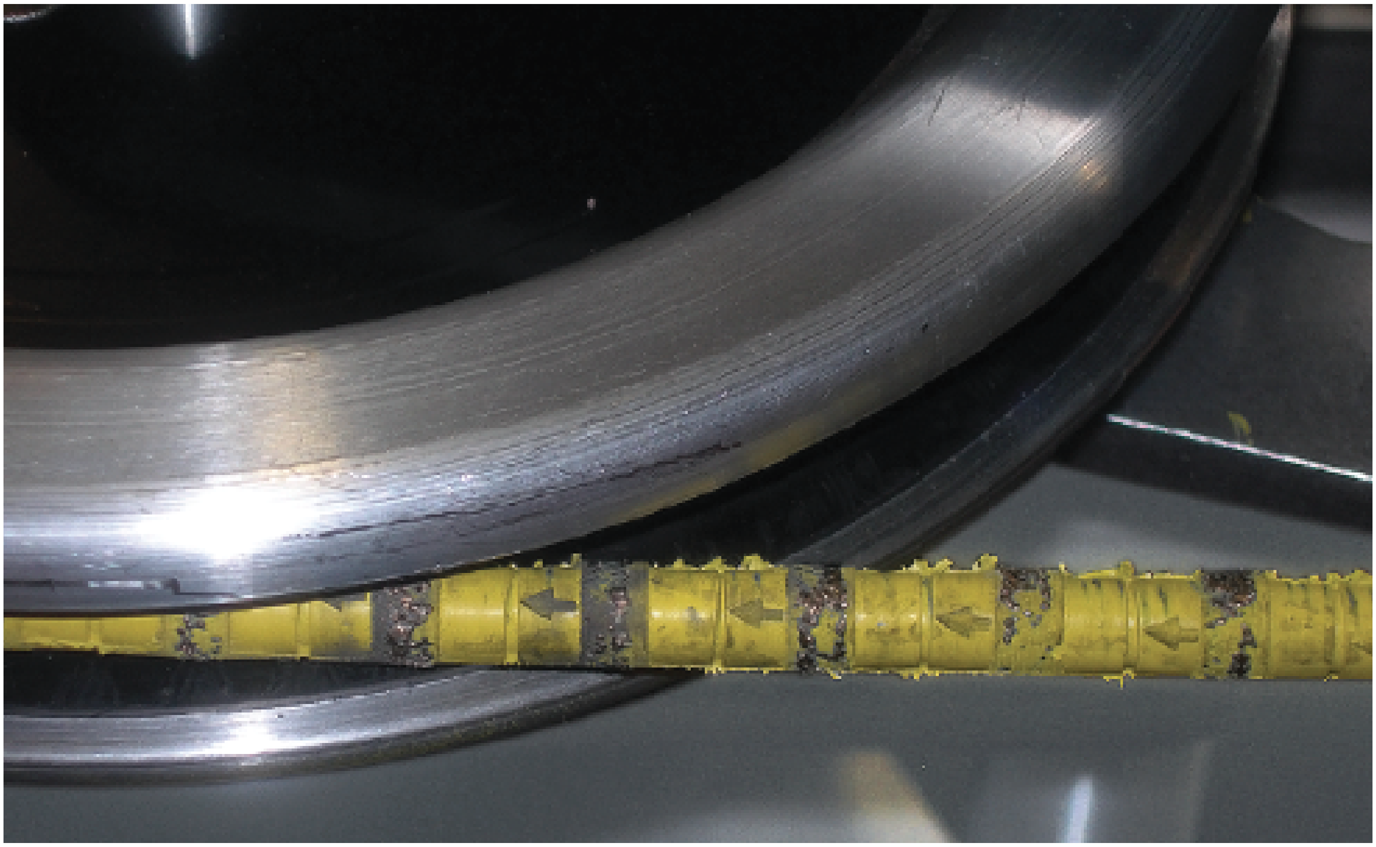

Fig. 5 — One of the hottest technologies in cold cutting is abrasive cutting diamond wire saws.

Milling

Milling utilizes a rotating cutter mounted to a carrier that follows a linear or radial path. Compared to lathe machining, milling produces fine chip debris and is not limited to 360-deg operation. This is particularly useful for localized machining of pockets or windows, or partial segmentation. Milling operations include cutting, beveling, facing, and grooving.

The modern market for pipe cold cutting technology goes back to 1949 with the introduction of the Trav-L-Cutter® by E. H. Wachs. It is a portable milling machine designed to cut, or cut and bevel simultaneously, on most pipe materials and schedules.

Reciprocating

Reciprocating cutting utilizes a straight blade moving in a repeated forward and backward motion to achieve the cutting action.

The advantages of reciprocating saws are their relative simplicity and ease of set up and operation. An example of this type of reciprocating saw is the Guillotine®, which cuts horizontally, vertically, or anything in between with an elliptical cutting motion that lifts the blade on the return stroke, enhancing cutting efficiency and minimizing blade wear.

These saws can be configured with remote control with auto feed and auto clamping operation for subsea or hazardous environments.

Chipless Cutting

Chipless cutting, also known as foreign material exclusion (FME) is designed to prevent cutting contaminants from entering the workpiece. Chipless cutting is often used in food and dairy, high purity, and power generation applications where metal shavings cannot be tolerated. In simple terms, FME utilizes a sharp edged wheel that orbits while inward pressure is applied to sever (cut) the work piece, much like a household can opener. Other examples where chipless cutting might be specified are hot cells, semiconductor, and deactivation and decommissioning (D&D) activities related to nuclear facilities, chemical agents, and explosive munitions.

Fig. 6 — Automated cutting technologies used for demilitarizing WWII aerial bombs in Guam.

To illustrate, the U.S. Department of Defense needed to destroy a WWII stockpile of chemical agents stored inside steel, cylindrical ton containers (TC) at a military storage facility. The project required the TC to be remotely severed without generating additional contaminates. Wachs' FME technology helped destroy over 1800 TC, successfully ending over 60 years of agent storage at the facility.

Abrasive Cutting

Abrasive cutting utilizes a hard matrix material bonded to the leading surface of various shaped cutting end effectors. The newest machine utilizing industrial abrasive cutting is the diamond wire saw (DWS), which cuts with a diamond matrix cable rotating at high speed, fed into the workpiece with controlled force. Diamond wire cutting is useful where the risk of material collapse, known as compressive cutting, exists.

It's the best solution when cutting mixed material types such as concrete and steel, which tend to quickly dull conventional saw blades. In addition, DWS set up quickly, making them useful for destructive cutting — Fig. 5.

Drilling and Threading

Drilling is a cutting process that utilizes a rotary cutting tool (drill bit) that is advanced into a workpiece to cut or bore holes, or remove material to enlarge a hole. Threading is a rotary cutting tool used to create screw threads. Traditional hydraulic powered industrial drills for drilling and threading are manufactured by E. H. Wachs, plus a line of specialized subsea drills.

Utilizing two hydraulically powered opposed drills, the subsea drill is designed to drill inline holes for pin insertion used for installing solid rigging bars. This procedure facilitates decommissioning and removal of structures such as multiple string casings and oil platform legs in near shore and subsea applications, so they can be safely lifted in larger, stable assemblies.

Cutting Automation

Automation technologies can be applied to cutting processes where human interaction is difficult or impossible, such as zero visibility, radioactive environments, explosive environments, and deepwater subsea operations. Automation options can include remote, topside or redundant controls, automatic feed, automatic clamping, ROV power and control, up to complete sequence automation with system integration — Fig. 6.

Repeatable Results

Properly machined weld preparations are a vital prerequisite to achieving the precise, high-integrity welds required in today's modern industries. Cold cutting, with subsequent or simultaneous beveling, produces the repeatable weld preps that contribute to weld integrity.♦