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ON THE EDGE

Exploring plasma bevel cutting for automatic weld edge preparation

According to field studies, up to 50 percent of parts produced throughout the CNC cutting industry worldwide require beveled edges for welding. If these reports are any indication, and they are, fabricators that plan on remaining viable in today's market should also plan on implementing or enhancing their bevel cutting operations.

Despite rising demand, however, many manufacturers, fab shops, job shops and metal service centers lack cutting machines, including plasma machines, equipped with beveling tool stations. Often this is traced to a general lack of awareness regarding the possibilities, availability and reliability of contemporary beveling tool stations. Today's advanced beveling tool stations deliver greater precision along with significant savings of production time and capacity and these benefits can easily outweigh the initial investment.

While the cost of advanced bevel cutting equipment can be significant, the absence of beveling capabilities can be even more costly. According to John Previsch, national sales manager for United Precision Services, automating the preparation of beveled edges on 3-D objects through the use of MicroStep's Rotator Tool Station delivers a greater financial benefit over the traditional use of advanced robots that come at a much higher cost.

"For weld preparation and bevel cutting on parts such as domes, pipes, rectangular or IPE profiles, robots were long considered to be irreplaceable," Previsch says. "Today, fabricators have access to an innovative and more cost-effective alternative that provides precise subsequent bevel cutting with gantry-type CNC cutting machines and eliminates the need for costly robots."

Bevel challenges

Achieving accurate bevel angles can be challenging due to factors like material type, thickness, speed and shape of the cut. Maintaining the ›

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In addition to its plasma offerings, fiber laser bevel cutting up to 45 degrees is also available from United Precision.

integrity of the cut edge is also crucial, as excessive heat can distort and warp the material. Additionally, controlling the plasma arc and preventing it from wandering or deviating from the desired path is a complex task, especially on curved or intricate cuts.

Manual grinding to create bevels – a common approach for so many welders and fabricators – opens the door to a number of errors, issues or inaccuracies during weld edge preparation. Some of the most common of these include:

- *Inconsistent bevel angle.* One of the most common errors is creating an inconsistent bevel angle along the edge of the metal. This can result in an uneven joint, where the weld may not penetrate properly, leading to weak spots in the weld.

- *Over-grinding or under-grinding.* Grinding too much or too little material from the edge can be problematic. Over-grinding can weaken the base material and compromise the structural integrity, while under-grinding may not remove contaminants or create a suitable joint for welding.

- *Lack of root face*. Failure to establish a proper root face (the flat area on the bottom of the groove) when grinding can hinder formation of a full weld penetration, resulting in a lack of›

Plasma and waterjet technologies can be combined on a single cutting plan, as shown here.

United Precision understands the various needs of its customers, delivering a variety of offerings, including pipe and profile plasma cutting combined with flat plate cutting.

fusion and reduced strength in the joint.

- *Inadequate cleaning.* Failure to thoroughly clean the metal surface before grinding and welding can lead to contamination, such as dirt, grease or oxides, which can cause porosity and weaken the weld. This error often occurs when proper cleaning procedures are not followed.

- *Rough surface finish.* A rough or irregular surface finish can create stress concentration points and decrease the quality of the weld. Inaccurate grinding can leave uneven, jagged edges, which should be smoothed to prevent stress risers in the weld.

Automated benefits

While manual plasma bevel cutting and/or grinding presents plenty of challenges, automating the process can provide several benefits including measurable improvements to cost, efficiency and quality. These benefits include:

- *Precision and consistency.* Automated plasma bevel cutting systems are programmed to cut precise bevel angles, depths and lengths, ensuring uniformity across all edges. This consistency minimizes variations in the weld joint geometry, leading to stronger and more reliable welds.

- *Improved efficiency.* Automation significantly reduces the time required to prepare edges for welding. Machines can work continuously without operator fatigue, resulting in faster project completion. This efficiency can lead to cost savings by reducing labor and project timelines.

- *Enhanced safety.* Automated plasma bevel cutting systems operate in a controlled environment, reducing the risks associated with manual grinding, such as operator exposure to harmful dust, noise and hand-arm vibration. This contributes to a safer working environment and improved worker health.

- *Reduced material waste.* Automated plasma bevel cutting optimizes material usage by minimizing the amount of metal removed during preparation. The precision of the cut minimizes the need for overgrinding, reducing material waste and cost.

- *Customizable bevel profiles.* These automated plasma bevel cutting systems can be programmed to create a wide range of bevel profiles to suit ›

specific welding requirements. Whether a V-groove, Y-groove or other customized profile, automated plasma bevel cutting can accommodate various weld joint designs with ease.

MicroStep's focus is on establishing automated CNC bevel cutting as a common and highly efficient production technology for preparation of quality weld edges on different types of materials. The company continues to build upon this tradition to further advance the technology and today MicroStep is putting automated CNC bevel cutting into the hands of more fabricators.

Over the years, MicroStep continually invested to enhance the mechanics and motion control of its rotary and 3-D tilting tool stations while leveraging the strength of suppliers for the development of energy beam sources and similar technologies. And although these machines produce high-quality and precise bevel cuts, operation remains relatively simple. The result is a comprehensive bevel cutting solution for a range of materials, thicknesses and applications.

MicroStep's advanced bevel cutting and supporting functions, such as automatic torch geometry calibration and adaptive bevel compensation, allow bevels to be cut using a variety of technologies including plasma, laser, waterjet and oxyfuel. Bevels can be cut in material thicknesses ranging from 0.2 in. to 12 in., and thanks to unique features of MicroStep's control system these machines can combine various technologies within a single cutting plan.

MicroStep machines provide two types of bevel cutting processes. The Direct Beveling Process represents the traditional method where a bevel is cut directly into the raw material such as sheet, pipe, profile or dome. The cut edge of the required shape (A, V, Y, X or K) is created via multiple consequent transitions of the cutting tool (at ›

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For increased productivity, United Precision offers parallel plasma bevel cutting of identical parts at the same time.

different angles) along the cut edge.

With dual rotatory heads, MicroStep machines allow identical parts to be cut simultaneously. The current maximum bevel angle of supplied tool stations is 52 degrees for plasma, 45 degrees for laser, 60 degrees for oxyfuel and 45 degrees for waterjet.

The Additional Beveling Process allows bevels to be added to parts that have been cut with a straight tool by plasma, laser, oxyfuel or waterjet. Generally, the accuracy of bevel cutting is determined by the mechanical accuracy of the cutting machine, the accuracy of the cutting technology and the stage of development of applied algorithms of control of the torch distance from the cut material.

Accurate advancements

Apart from consistent use of high-quality components, the accuracy of MicroStep machines is enhanced through several advanced solutions.

- The intelligent torch holder feature ensures protection of the torch in case of collision. Its slip-back function ensures the return of the torch into the correct position. The body includes an advanced sensor system for detection of the exact torch position and provides the endless rotation function.

- Auto-calibration of tool geometry (ACTG) ensures that during rotation and tilting of the bevel head, the torch tip always remains in the required position. The ACTG system consists of a calibration station, torch extension probe and advanced control software. Eliminating the need for a mechanical adjustment of the bevel head, ACTG slashes machine setup time from several hours to minutes.

- Compensation of longitudinal displacements is an optional function that ensures absolute accuracy of the machine in the longitudinal direction. During installation, the machine is measured by a laser interferometer and the measured values are used for calibration of the positioning system. The measurement can be applied for cutting long parts demanding high accuracy.

- Accuracy of the cutting technology is enhanced by eliminating beam deviations that occur naturally when the torch is in a tilted position in relation to the material. This tilt can cause an unwanted difference of the ›

Thanks to United Precision's Additional Beveling Process, bevels can be added to parts that have been cut with a straight tool by plasma, laser, oxyfuel or waterjet.

cut angle from the theoretically programmed slope.

- Advanced bevel corrections (ABC) is an advanced feature for compensation of beam deviation. ABC enables implementation of databases of compensation angles and other values for various cutting technologies (e.g., Hypertherm's True Bevel technology). The compensation values can also be adjusted directly by the machine operator.
- Self-teaching height control (STHC) is a smart height control system that ensures the torch is always positioned at the correct cutting height at any angle during plasma bevel cutting. STHC is a combination of 3-D motion control, self-teaching algorithms and adaptive height control according to the plasma arc voltage.

Manufacturers and suppliers are constantly scrambling to keep in step with industry requirements to attract and retain key accounts. And for fabricators today this means bevel cutting. MicroStep's plasma bevel cutting is widely used throughout Europe and other parts of the world. Now, thanks to its partnership with United Precision Services, this technology is available to North American fabricators.

"Plasma cutting beveled parts for weld preparation was once a multi-step process requiring a hefty investment in robotics," Previsch says. "MicroStep machines have a long reputation for quality and precision. Together, we're providing North American fabricators with quality parts at a fraction of the time and cost." ■

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