// by Robert Farrell, president, Farrell MarCom Services //

BEYOND FLAT PLATE

Dome cutting creates real challenges in 3-D, but implementing the right technology eases the complexities

In any business, adding capabilities and services can have a measurable impact on the bottom line. And many fabricators have expanded their offerings to attract customers from new industry sectors. This could include adding painting, welding, laser cutting, beveling or bending to a company's operations.

Living in a 3-D world, more fabricators are beginning to venture beyond flat plate cutting to diversify their offerings. But processing pressure vessels, boilers and similar 3-D objects generally presents some unique and significant challenges.

As with any traditional job, cutting operations must be fast, simple to set up, and produce clean and accurate results that won't require added manual cleanup. When it comes to 3-D objects, however, this is often easier said than done.

The dome cutting process typically includes creating openings in the dish end of the vessel to allow for the welding of inlet pipes or slicing or trimming of the edges and to prepare the end to be welded to the vessel body. Accuracy is critical as the cross-sections of the cut edges must meet the requirements of the subsequent welding process. Depending on the wall thickness, V, X or K cuts with constant or variable bevels must meet the prescribed accuracy. Failure to do so means poor quality, excessive scrap and lost contracts.

A better process

Until now, few fabricators possessed the resources and experience to confidently take on cutting domes and other 3-D objects. Fortunately, however, MicroStep, a machine manufacturer based in Slovakia and with a presence in 58 countries worldwide, developed a special beveling tool station designed to make the process more automated, efficient and reliable. The station allows for tilting the cutting tool up to 120 degrees with a big enough stroke to reach across the entire surface of the dome.

To ensure that contours and openings are precise and compliant with ›

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production requirements, MicroStep developed mScan – an advanced 3-D laser scanning process and corresponding point cloud mapping software. The software enables a CNC plasma cutting machine to measure the true shape of a 3-D object, such as a dome, and use this information to guide the cutting process.

According to John Previsch, national sales manager at United Precision Services, the North American distributor of MicroStep equipment, MicroStep's 3-D scanning technology has a significant impact on dome cutting accuracy.

"The real dimension of a dome can lay within allowed tolerances, which ›

↑ *Dome cutting is used to create openings in the dish end of vessels, such as the one shown here, to facilitate the welding of inlet pipes and to prepare the end to be welded to the vessel body.*

MicroStep's technology is able to create a detailed 3-D model of an object while fully describing its parameters, including any deviations from the ideal shape.

means that the real and ideal shapes of domes sometimes differ by several centimeters," Prevish says, adding that "conventional 2-D methods of positioning corrections via control of plasma arc voltage do not apply to 3-D cutting.

"The MicroStep scanner allows fabricators to create a model of the actual dome surface within the coordinate system of the cutting machine," he continues. "This model can be used to analyze the shape of the dome, identify its center and define the exact toolpath above the surface. The results are precise cuts and significant savings by processing domes with multiple openings and welding preparations."

How does it work?

During the scanning process, MicroStep's iMSNC control system receives data from the 3-D scanner and pairs it with positions of all motion axes of the machine. The measured positions are further adjusted by applying displacement corrections of axes positions based on the exact measurement of machine kinematics by a laser interferometer as well as the calibration data of the bevel head and scanner itself (obtained via MicroStep's patented auto-calibration technology called ACTG).

As a result, the control system has information regarding the exact position of the scanned object with respect to the cutting tool. This enables exact scanning of the object within the coordinate system of the cutting machine. The scanner then uses mScan to create a detailed 3-D model ›

Watch the video to learn more about MicroStep's dome-cutting solution.

The software from MicroStep enables a CNC plasma cutting machine to measure the true shape of a 3-D object, such as a dome, and use this information to guide the cutting process.

of the object while fully describing its parameters, including any deviations from ideal shape.

MicroStep's 3-D CAM software mCAM is used to map the ideal cutting path onto the scanned object. Subsequently, a new cutting plan is generated to fit exactly the true shape of the scanned object. Automatic processes are displayed for the operator in the form of 3-D visualizations on the control system screen. All of this happens in just 2 to 10 min., depending on the dome size.

Sometimes, it isn't necessary to perform the entire process, saving time. For example, if it's only necessary to measure the dimensions of the dome, it is enough to scan a cross (+) projected over the top of dome to determine the exact position of the dome's top.

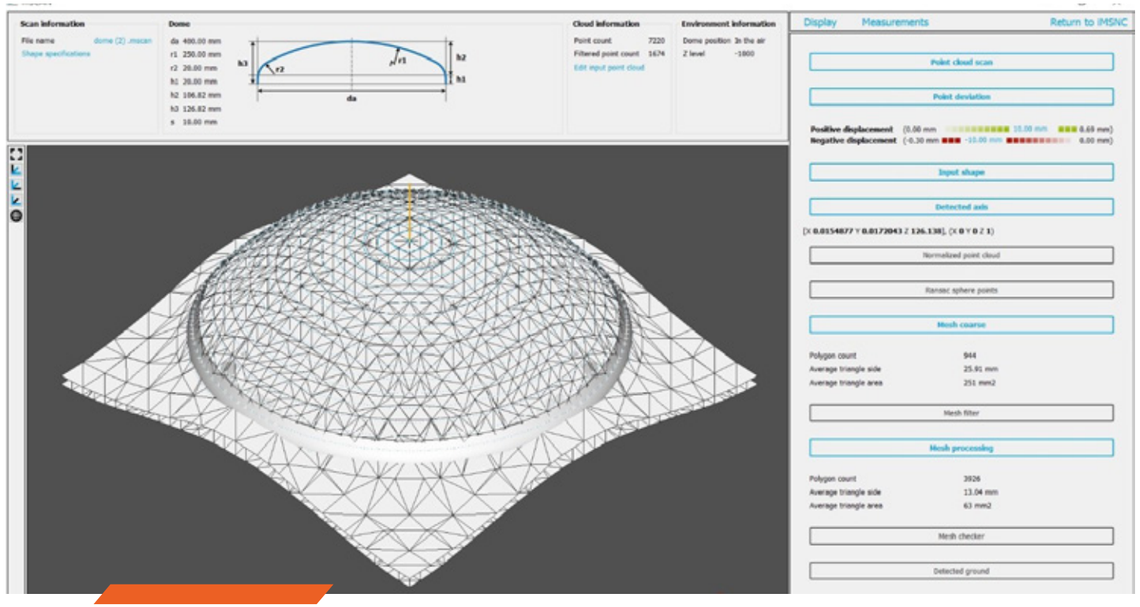
This area can be marked with a marking head or directly with a plasma torch. Also, if the cutting plan involves just a part of the dome surface (such as the spherical top part that is usually quite flat) it is not necessary to scan the entire dome. In case of cutting into the flatter top part, the height control during cutting can be based on plasma arc voltage – a standard function of any MicroStep plasma cutting machine.

All processes and 3-D scanning functions are handled by the machine operator or easily accessed via a company network. Additionally, mScan provides an analysis of shape geometry – a comparison of the true and ideal shapes of the scanned object, which in itself is a powerful tool for verification of production output in production of domes and other 3-D objects.

Expanding markets

Thanks to the modular structure of MicroStep machines in terms of machine dimensions, types and locations of cutting zones, and configurations of tool stations, a machine can be custom designed for nearly any requirement. And with this versatility, a single gantry with a ›

> Business today is highly competitive, and fabricators are scrambling to differentiate themselves and penetrate new markets.



↑ *mCAM, the 3-D CAM software from MicroStep, maps the ideal cutting path onto a scanned object.*

beveling tool station, 3-D scanner and marker can be used for processing 3-D objects as well as flat sheets.

Business today is highly competitive, and fabricators are scrambling to differentiate themselves and penetrate new markets. MicroStep offers an attractive solution for those ready to tackle 3-D cutting.

MicroStep's solution for cutting beveled penetrations into dome heads using a gantry-style machine equipped with scanning is commonly used throughout Europe and other parts of the world. United Precision now brings this unique technology to the North American marketplace. ■

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