# m3Plasma system tested for weld preparation

FastCAM Pty Ltd has produced a new digital bevel head, designed specifically for the creation of true 3D 'weld ready' shapes from steel. The most useful common application for FastCAM's new technology is precise weld preparation for flat and formed plate although pipe cutting with bevels is also supported. Testing commenced in early 2009, in Canada.

The object of the first test was a tolerance in every dimension of +/-1mm required for weld preparation, even on a very small part.This was achieved with the precision of the m3Plasma torch. Having established accuracy, the second challenge was the preparation of a rolling weld face K bevel for formed plate (VBA or Varying Bevel Angle). The key distance to observe is the depth of the top and bottom of the root face or land. This must be constant regardless of the angle of the weld face.The access grooves are cut at 30 degrees relative to the weld face. Again it was totally successful with the precision of the m3Plasma torch. The land is particularly sensitive to the slightest error in position, kerf, feedrate, or torch height.

The quality of the cut from the m3Plasma means minimum cleaning or grinding is required for perfect results. Using the latest in high precision torches with the rapid switch between cutting and marking means the parts can be marked for forming and labeled, further reducing forming and assembly times.

A separate challenge was to ensure that the weld specifications could be originated from the drawing office in a way that translated seamlessly to the NC cutting machine.

Shows the simulation of the NC code in the FastCAM® 3D Programming System. Note the complex vectored corners and stationary points for the machine. Red is an undercut and blue is top cut.

The goal was to achieve the level of automation that the machining industry has enjoyed for years, where they send 3D files through to 5-axis machining centers, knowing that the end result will be perfect.

A test part with a symmetrical K bevel cut in three passes on 25.4mm plate, 10, 5.4, 10 at 30 degrees.

In the new FastCAM 3D approach, the breakthrough concept for plate cutting was to adapt the 2D format to include 3D weld information in a parameterised form, so that the file can be transmitted, edited, nested and cut in the usual production manner.

To ensure absolute control over accuracy, all welding specifications can be independently defined by the original designer, based on complete drawings, design and welding standards and workshop practices.

The new format allows for a non-vertical weld face, non-orthogonal tangent vectors and continuously varying weld faces. Using the annotated 2D file provided by the drawing office, the programmer only has to load this same file into the FastCAM 3D processing system. All the elements are in 2D to allow for machine independence. The file can be used by triple torch oxy, single torch plasma, water jet, laser or any

Variable dihedral K preparations generated by FastCAM.

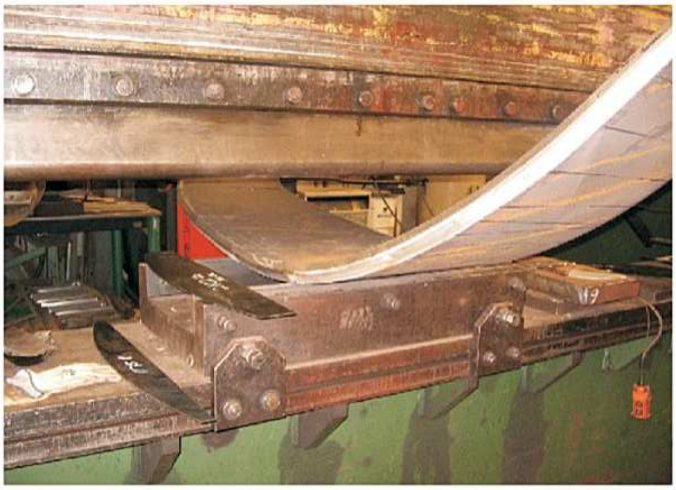

Plate forming

other process. Details of offsets, multiple passes, corners, notches and the rest are all handled in the usual way by the nesting software. Weld prepared parts can be freely mixed with standard cut parts for material optimisation. The end result is a true 3D object from a 2D machine.

These CAM files are also generated by complementary software programs such as FastSHAPES so as to completely automate the development and forming of transitions for all the different segments in the heavy engineering market, from simple Cones and Mining Buckets to complete Hydro-Electric Pen Stock type developments.

This new approach to fabrication will totally eliminate grinding from almost all weld preparation, limited only by the maximum angle of the m3Plasma torch at 55 degrees.

This means not just an increase in productivity, but the complete elimination of an entire process in fabrication and all the double handling. It also means contract cutters and service centers can be certain of their results, mixing square cut parts and beveled parts with ease. Dr. Matthew Fagan of FastCAM, was thrilled with the results, saying "After 20 years, we have finally made a breakthrough on accuracy, simplicity and cost, making automated weld preparation of heavy engineered parts a viable reality." AMT

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### About FastCAM

Established in 1978, FastCAM Inc. is a software company specialising in NC plate processing with over 36,000 NC programming systems throughout the world.

FastCAM is located in three locations: FastCAM Inc. in Chicago, USA, FastCAM Pty. Ltd. (Research & Development) in Melbourne, Australia and FastCAM Shanghai, in China.

Dr. Matthew J. Fagan, Ph., invented interactive graphic nesting in 1983, even before the creation of the PC. His vision was to make programming simple and affordable. For the last decade he has focused on simplifying and automating weld preparation.

## Plasma weld preparation in industry

Most plate has to be weld prepared, however automated weld preparation not been widely accepted for fabrication. Traditionally, only a small percentage of NC plate cutting machines are beveling machines. Even those are used mainly in single pass chamfering for shipbuilding.

However primary industries such as mining, transport, road works and agriculture, are moving to harder Q&T steels with more strength, more impact resistance, more wear resistance and other special properties. These materials are much harder to grind so weld prepared parts straight off a cutting machine has the potential to offer a dramatic savings for a much larger market segment.

For a weld prepared part to be acceptable, there must be an overall accuracy of +/- 1mm. However machines, torches and programming systems are still tested by this type of application which is machining, not rough flame cutting. For many reasons, it just has not worked or has been too expensive or too complex. Where accuracy is required, there are varied inherent problems such as torch height control, special logic for loops, corners, adjustment to kerf, feedrate and more. A small error in the head position, horizontally or vertically means a big shift in the position of the small land formed in a 'K bevels'.

To complicate matters further, there are multiple ways in which a drawing can be defined. Thus a simple rectangle is not enough. When bevelled you have to know if you are looking at the top, the bottom, half way through or even the top on one edge and the bottom on another, with the biggest or smallest rectangle approach. In many cases, the NC programmer has had to tackle problems best left to a welding engineer. If not calculated correctly, you may have a beautiful bevel but on a part which is too big or too small and does not fit.

Steel service centres have been reluctant to take responsibility for accurate weld preparation for customers. It is a specialist job and they usually do not have the full set of drawings, the 3D systems or the ability to read the complex weld diagrams or to perform the offset calculations. For a variety of reasons, the old approach of manual or semi-automatic weld preparation is still the standard, despite the huge labour and time penalties.