Through Arc Seam Tracking vs. Joint Geometry

Defining a More Robust Process Window

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Introduction

Through-Arc-Seam-Tracking (TAST) is the process of integrating current as the welding torch oscillates across the joint. By analyzing this data, the controller can alter robot travel to correct for joint misalignment. The motion of the torch has an effect on performance. To produce an appropriate operating envelope, this effect must be taken into account. Weave frequency and amplitude must be balanced so that proper torch correction can be achieved without sacrificing weld quality or penetration.

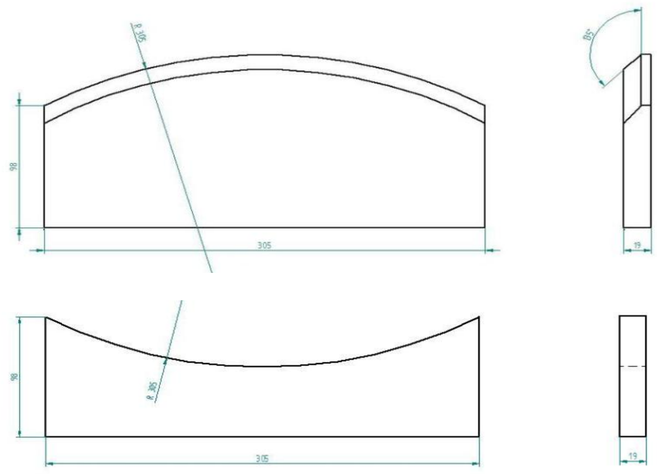
Welding Setup

In order to understand the effect of joint geometry on the Through Arc Seam Tracking (TAST) process, the initial weld trial involved half-bevel plates with 30°, 45°, and 60° bevel angles. The final weld trial included only 30° and 45° angles.

Initial welding parameters were determined on a plate with 0° offset, and the end of the plates was rotated around the starting point to an offset of 5° or 10° to ensure that the TAST was activated.

The weave frequency and weave amplitude were varied independently to determine their limits and define the process window.

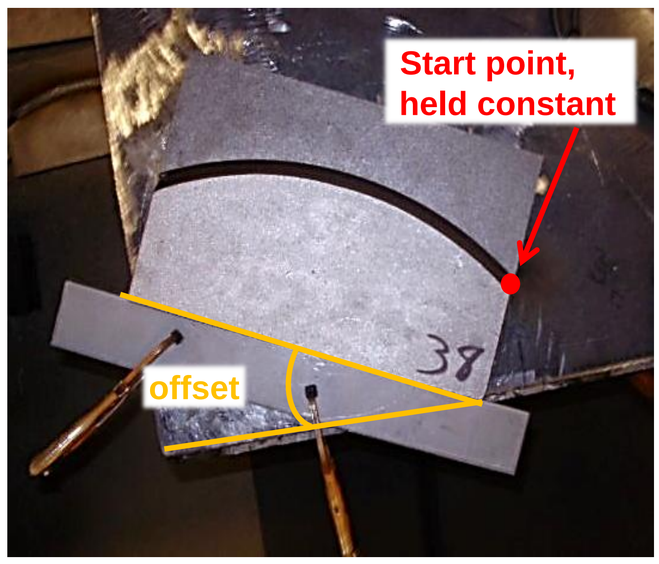
Plate design



Good tracking

Failed tracking

Plate setup



Cross section to show penetration

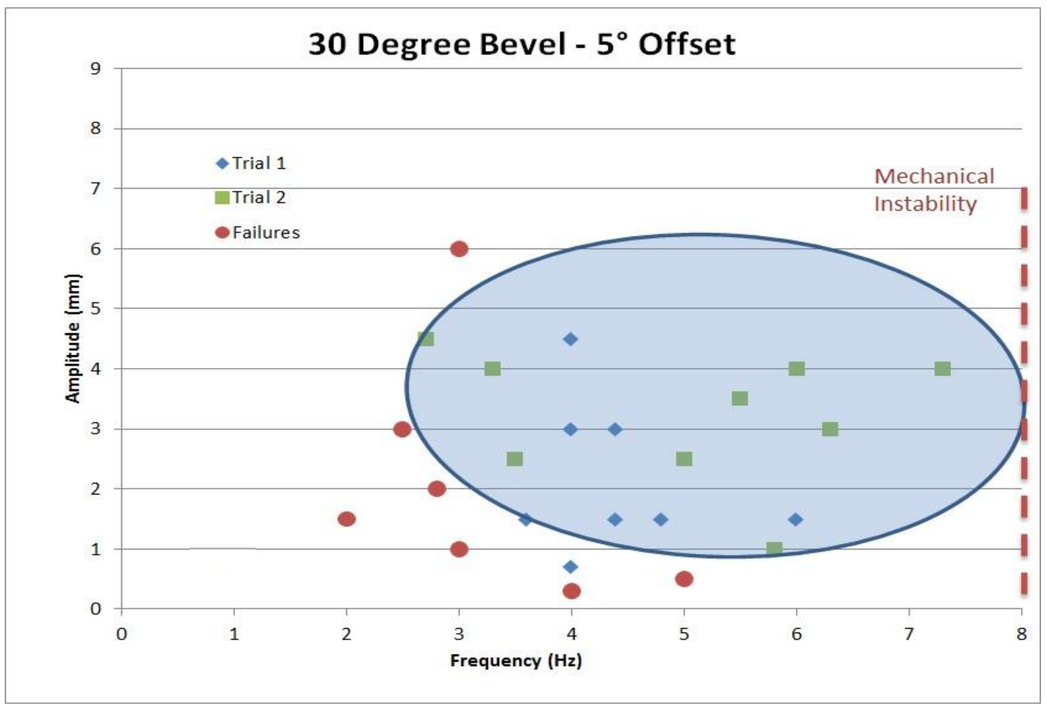
Parameter Variation

- The weave frequency and amplitude were varied in order to determine the process window.

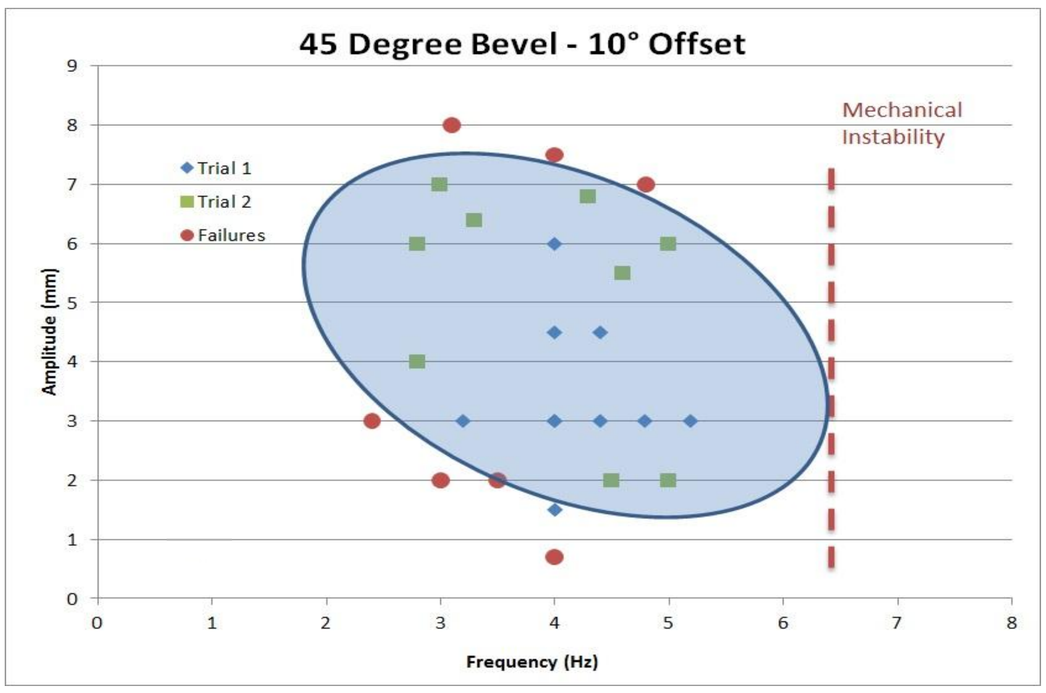
	Variables				
Sample	bevel angle (deg)	weave frequency	weave amplitude	failure	offset (deg)
1	30	4.4	1.5	no	0
2	30	4.4	1.5	no	5

Example table of parameters used for the two weld trials. Voltage was held constant at 28 volts, the wire feed speed was 350 ipm, the travel speed was 12 ipm.

Results



Graph of the results for the 30° bevel at a 5° offset. The red points are failures, defined as either TAST failure or a defect, such as undercut, as defined by D1.1. The blue points are acceptable trial 1 welds, and the green points are acceptable trial 2 welds. The shaded oval is the projected process window.



Graph of the results for the 45° bevel at a 10° offset. The red points are failures, defined as either TAST failure or a defect, such as undercut, as defined by D1.1. The blue points are acceptable trial 1 welds, and the green points are acceptable trial 2 welds. The shaded oval is the projected process window.

The 60° bevel plates never had a seam tracking failure, although not all of the welds met D1.1 requirements. It was decided while the 60° bevel was more robust, it would not be practical in a production environment and so was not tested during the second weld trial.

Conclusions

- No tracking failures occurred with the 60° beveled plates, however the cost and time required to fill the joint makes it less efficient than the smaller 30° and 45° bevels.
- The 45° beveled plates had a greater tolerance for offset than the 30° plates.
- If kept within the process window, the 30° bevel performs well enough to justify its use over 45°.
- For the prequalified parameters, penetration meets requirements within the operating envelope.
- Penetration increases with lower amplitude and frequency.
- Although a higher frequency results in greater reliability in tracking, it causes mechanical instability at excessive levels.

Acknowledgements

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