

## **SPB5. Effect Of Torch Weave Parameters On Weld Bead Characteristics**

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### **Introduction**

Caterpillar sponsor was interested in how weave variables affect weld bead profile and penetration. Their intent is to use weaving to improve fatigue life by eliminating stress concentrations at weld toe. The objective was to conduct experiments to investigate the effects of torch weave parameters (amplitude, dwell time, and frequency) on weld bead characteristics (root penetration, dilution, undercut, leg size, toe angle). Also, we wished to determine which weave parameters have most impact on reducing stress concentration at the weld toe. The work was carried out using DOE, or statistical analysis, due to its efficient study of variables.

### **Technical Approach & Results**

The nominal GMAW-P welding parameters and feasible magnitudes for their variations were pre-determined from ad-hoc experiments performed prior to the DOE design. The DOE algorithm produced a matrix of coded weave parameter values (weave amplitude, frequency and dwell time) for both 6mm and 8mm fillet sizes.

Weld made according to the matrix were cross-sectioned and etched and video images were analyzed with N.A.M.E.S software to measure weld bead characteristics (root penetration, dilution, undercut, leg size, toe angle). The results were entered into Minitab and quadratic regression models were created, along with resulting R<sup>2</sup> values. The correlation data (R<sup>2</sup> versus Bead Characteristic) was plotted, and the two bead characteristics with highest R<sup>2</sup> (root penetration and weld toe angle) were analyzed further. Sigmaplot was used to plot the selected bead characteristics versus weave amplitude and weave frequency with dwell time constant at low, medium, and high values.

It was noted that, for both weld sizes, as dwell time was increased, toe angle decreased. However, frequency and dwell time had negligible effects on root penetration. Recommended optimum parameters were created by trying possible combinations of weave parameters in order to find the best combination of maximum toe angle and penetration and minimum undercut.

### **Conclusions**

- Bead profile is dependent on weave parameters and weld size.
- In order to maximize fatigue life (large toe angle, sufficient root penetration), the following combination of weave parameters should be implemented for the respective fillet size:
- 8-mm: medium amplitude, low frequency, low dwell time
- 6-mm: low amplitude, high frequency, low dwell time