Spray Transfer versus Advanced GMAW-P

By: Shane Markham

BACKGROUND

Spray transfer:
Commercially applicable since the 1960’s, the spray transfer process has been the mainstay in heavy equipment fabrication and applications requiring high levels of metal deposition along with penetration deeper than what could be achieved with the short arc process.

Advanced GMAW-P (Accu-Pulse™):
The advancements in GMAW pulsing technology of the 1970’s are in large part due to more advanced power sources and control software that manipulates the arc waveform at rates that analog systems cannot achieve. This has led to the development of power sources such as the Miller Accesx and Continuum™ line of advanced GMAW machines.

PROCEDURE

Material: 1” thick-by-6-inch long low carbon steel plate; single bevel at 45°
Position: Plates placed in the 2G position
Inner Pass Processing: After each weld the silicon is chipped off and wire brushed to reduce the chance of inclusions and other discontinuities. the weld will be below 350°F before the next pass.

Machine:
Miller Axcess 300 with Axcess 40V feeder and a Bernard Q gun, connected to a 460V single phase power supply running ESAB .045 ER70s-6 wire. During spray testing the machine is set to 30V with a WFS of 390 per the Miller Weld Calculator Guide. For the Accu-Pulse testing the WFS is set to 400 with a 60 arc adjust setting.

TEST

Figure 1: Test coupon tacked to backing bar with ¼” root gap both tests were set up using this exact same set up

Figure 2: Accu-Pulse (top) 1st pass before silicon is chipped and brushed; Spray (bottom) 1st pass before silicon is chipped and brushed.*

RESULTS

Spray
10 Berries in center 4”
Average weld speed of 27.66 IPM
Average HAZ depth of 0.059”
Average depth of penetration of 0.118”
Maximum depth of penetration of 0.187”
Average heat input of 43883.24kJ per pass

Accu-Pulse
6 berries in the center 4”
Average weld speed of 27.79 IPM
Average depth of the HAZ was 0.068”
Average depth of penetration 0.157”
Maximum depth of penetration of 0.25”
Average heat input of 34959.24kJ per pass

Graph 1: Weld speeds taken during specific passes throughout the testing process.

Figure 3: Bend test coupons were milled down to between 0.385-0.395 Spray (Top) Bend test results from spray coupon. Accu-Pulse (Bottom) bend test coupons. Neither test displayed any discontinuity(s)

Table 1: No material specifications were available for the plates used however the hardness test (using Rockwell B scale) shows no significant hardening of the coupons in the HAZ or weld area. Measurements were taken from the centerline of the weld (in).

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<th>Accu-pulse</th>
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CONCLUSIONS

Thank you to Dr. Rick Polanin for the guidance and technical assistance during this project

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50% fewer berries using Accu-Pulse
Nearly identical travel speed
Better penetration using Accu-Pulse
Neither bend test showed any discontinuities
Accu-pulse put less heat into the part with equal or better penetration

Advantages of using Advanced GMAW-P must be weighed against the higher cost of the machines compared to standard GMAW power sources