WELDING PRESSURE VESSELS WITH ICE™

INCREASED PRODUCTIVITY WITH HIGH QUALITY

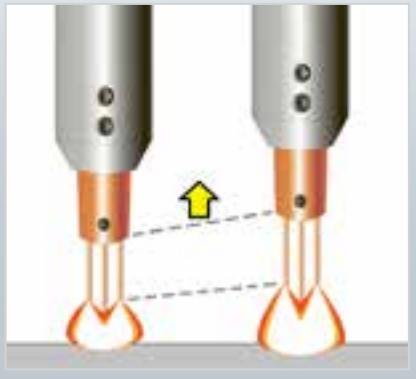
WHAT IS ICE™?

Welding of Pressure Vessels has been done using submerged arc welding since SAW was introduced. SAW allows for high quality welds and high deposition rates that are huge benefits to manufacturers of heavy wall pressure vessels.

ESAB's ICE™ Submerged Arc Welding process gives manufacturers a new way to increase deposition rates without jeopardizing the high quality requirements. ICE Stands for Integrated Cold Electrode which when you look at it in its simplest form, is SAW with the addition of Supplemental Fill as defined by in ASME Sec IX. SAW with supplemental fill has been around for 30 plus years as a variable in ASME welding codes. ESAB has taken this to the next level by moving the position of the supplemental fill wire to a position that maximizes the robustness of the process. The cold wire is moved from the front of the SAW process placed between two (2) hot electrodes (Twin SAW) using a single power source and controller. Some major advantages to ESAB's ICE process is using cold wire that is electrically insulated from the two welding wires from feeder to tip.

All wires are 3/32" diameter to maximize arc stability and minimize equipment size. With ICE, the cold wire is a percentage (CWF) of the hot wire feed rate. This allows for an increased deposition rate without changing the main welding parameters.

Cold wire melts as a result of the excess heat generated by the two hot wires. The cold wire feed speed is software controlled with the hot wire feed speed to ensure controlled feeding rate. The melting position of the cold wire will adapt to the arc if the welding conditions change - **unaffected by variations in stick out and unaffected by variations in arc length.**



When combining ESAB's SAW welding equipment options with our large filler metal selection for pressure vessel materials, the result is a complete solution that increases your deposition rate without sacrificing the high quality you expect from traditional SAW.

Examples of base materials and applications

- Unalloyed Steel
- Low-alloyed Steel
- High-alloyed Steel
- Stainless Steel
- Wire Cladding

PRODUCTIVITY COMPARISON

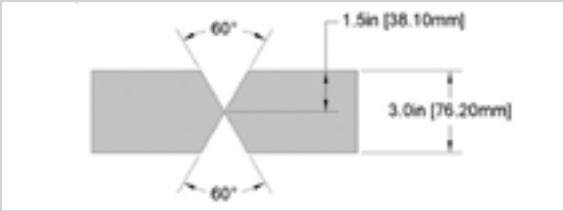
Application: Double bevel Groove weld with 60° included angle and a thickness 3” (76.2mm).
Filler metal: SAW: ESAB Spoolarc 71 (EM14K) + ESAB OK Flux 10.62 (Classification F7A6-EM14K / F7P6-EM14K)

Single wire 5/32 (4.0mm)

- Average Amperage: 600 A
- Average Voltage: 32 V
- Average Travel Speed: 18ipm (45.7cm/min)
- Maximum Heat input: 63,5 kJ/in (2.5 kJ/mm)
- Average Deposition rate: 12.3 lbs/hr (5.6 kg/hr)
- Total number of passes: 55

ICE, 3x 3/32” (3x 2.5mm)

- Average Amperage: 800 A
- Average Voltage: 31.5 V
- Average Travel Speed: 24.6ipm (62.5 cm/min)
- Maximum Heat input: 63,0 kJ/in (2.5 kJ/mm)
- Average Deposition rate: 33,0 lbs/h
- Total number of runs: 38



37% increase in travel speed
168% increase in deposition rate
31% decrease in number of passes

CUSTOMER CASE - CARBON STEEL

J&M Welding out of Tulsa Oklahoma was looking to upgrade their shop with more robust SAW equipment. They also wanted welding application support to maximize prodcutivity increases. So J&M partnered with ESAB Welding & Cutting to update an existing side beam system with a new ESAB SAW package which included ICE.

The old process was single wire SAW 5/32” which achieved a depostion rate of 15 lbs/hr.

Application

- Pressure Vessles & Box Headers
- Change from Single 5/32” to ICE

Filler metals

- ESAB Spoolarc 81 / ESAB OK 429
- ESAB Spoolarc 71 / ESAB OK 10.72

Performance

- Deposition rate average: 42 lbs/hr
- Welding speed: 24 ipm

Benefits

- Decreased welding time by 40%
- Increased Deposition Rate by 180%

CUSTOMER CASE - STAINLESS STEEL

The task for ESAB was simple. Maintain the high quality but increase productivity.

At this well-known Italian pressure vessel manufacturer, the quality is the key, but how would we increase productivity without jeopardizing the quality? The current set-up is using a 1/8” wire with a deposition rate of 16.5 lbs/h.

Application

- SA 240 Type 321
- 6” thickness
- Change from Single 1/8” to ICE

Filler metals

- OK Autrod 347 / OK Flux 10.93

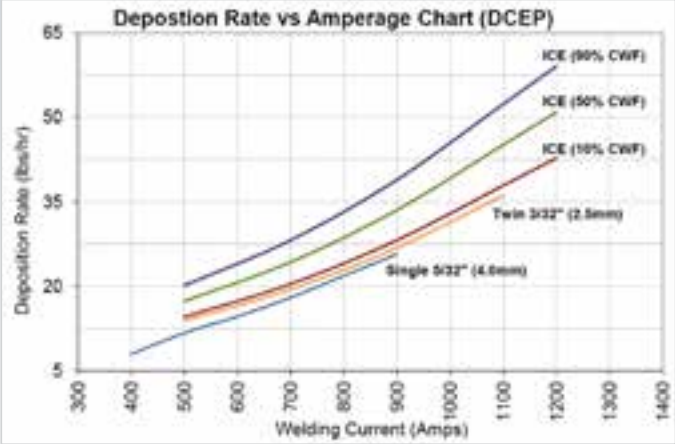
Performance

- Deposition rate average: 31 lbs/hr
- Welding speed: 35 ipm
- Heat input: 40.6 – 45.7 kJ/in

Benefits

- Increased deposition rate by 91% compared to current solution

PROCESS COMPARISON



Comparison at 800 Amps

- Single 5/32” (4.0mm): 21.9lbs/hr (10.0kg/hr)
- Twin 3/32” (2.5mm): 22.9lbs/hr (10.4kg/hr) or 4.6% increase over Single 5/32”
- ICE at 10% CWF: 24.1lbs/hr (11.0 kg/hr) or 10.0% increase of Single 5/32”
- ICE at 50% CWF: 28.5lbs/hr (13.0kg/hr) or 30.1% increase of Single 5/32”
- ICE at 90% CWF: 33.4lbs/hr (15.2kg/hr) or 52.5% increase of Single 5/32”

ASME QUALIFICATION REQUIRMENTS

Qualification in accordance with ASME Section IX, the following will require requalification of the procedure based on the original PQR(s) that were qualified.

Essential Variables

- *(QW-404.24)* addition or deletion of supplemental filler when the original procedure was qualified without supplemental filler metal.
- *(QW-410.24)* a change by more than ±10% of the volume of supplemental filler metal deposited when the original procedure was qualified with supplemental filler metal.
- *(QW-404.27)* a change in the composition of the ICE wire will require requalification.

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GLOBALLY CERTIFIED MANAGEMENT SYSTEMS

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