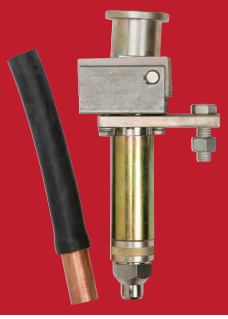
THE LINCOLN ELECTRIC COMPANY

NEXTWELD®

# Up To 100% Increased Deposition Rates



## Extended Electrical Stickout Yields Significant Increases in Deposit Rates with the Power Wave® AC/DC1000® SD

Application

**The use of extended electrical stickout (EESO) is not new. This process variation has been limited in the past by the understanding of the process and the limitations in controlling traditional equipment**

**Lincoln Electric Waveform Control Technology®, embedded in the new Power Wave® AC/DC 1000® SD power source and the new MAXsa™ Controllers and Feeders provide the ability to take full advantage of this process.**


### UNMATCHED PRODUCTIVITY INCREASE

- Recommended for applications requiring a large amount of deposit per unit of length.
- Use as a heat input reduction tool without sacrificing the deposition rate.
- Up to 100% increase in submerged arc welding deposition rates over traditional DC+ procedures.

### COMPLETE CONTROL

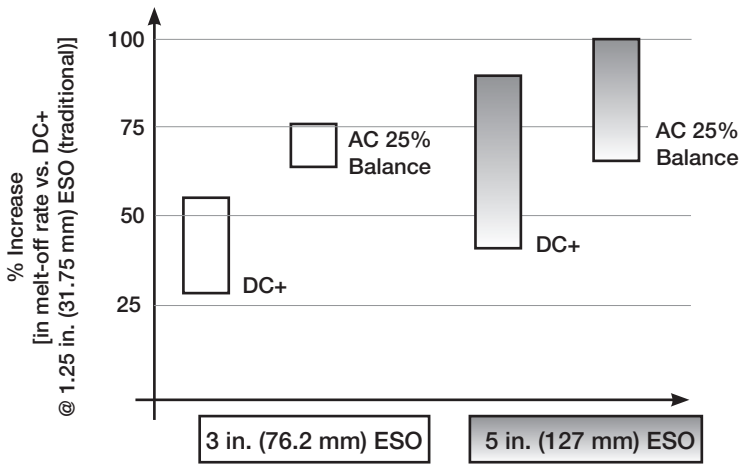
- Eliminate arc striking problems by allowing complete tailoring of the arc start characteristics.
- Precise control over the input of energy into the weld.

### ENABLED BY STATE-OF-THE-ART EQUIPMENT

- Power Wave® AC/DC 1000® SD
- MAXsa™ 10 Controller
- MAXsa™ 22 Automatic Feeder

**Using Extended Electrical Stickout**

**5/32 in. (4.0 mm) Electrode @ 500-900 Amps with the Power Wave® AC/DC 1000® SD**

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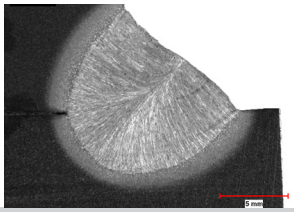
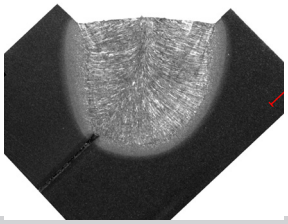
## Examples



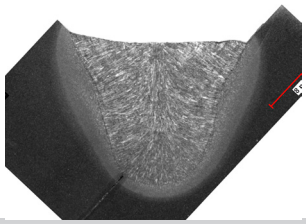
**5/16 in. (7.9 mm) Horizontal Fillet Weld**
- AC balanced square wave
- 5 in. (127 mm) ESO
- 775 amperes
- 40-41 volts
- 36 ipm travel speed

**80% TRAVEL SPEED INCREASE**



**3/8 in. (9.6 mm) Flat Positioned Fillet**
- 5/32 in. (4.0 mm) L-61/761 flux
- 5.00 in. (127 mm) ESO
- AC 25% balanced wave
- 800 amperes
- 39 volts
- 30 ipm travel speed

**36% TRAVEL SPEED INCREASE**



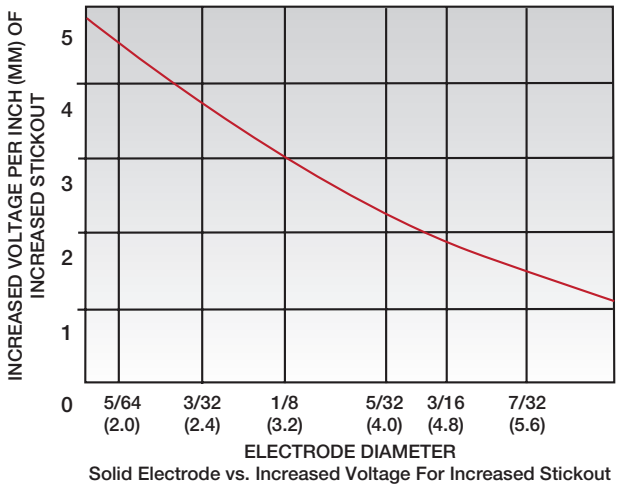
**1/2 in. (12.8 mm) Flat Positioned Fillet**
- 5/32 in. (4.0 mm) L-61/761 flux
- 5.00 in. (127 mm) ESO
- AC 25% balanced wave
- 760 amperes
- 42 volts
- 16 ipm travel speed

**60% TRAVEL SPEED INCREASE**

## Voltage Considerations

When converting an existing procedure to take advantage of longer ESO, some upward voltage adjustment will be required.

Use Figure 1 for estimating the increased voltage needed from an existing procedure.




**Solid Electrode vs. Increased Voltage For Increased Stickout**

Figure 1

## Excellent and Repeatable Arc Striking

To test and verify arc starting characteristics, some simple tests were conducted. Operators started a bead-on-plate, allowed the arc to stabilize and then terminated the bead. Between each cycle, the electrode was cleanly cut to a point and the cycle was repeated. The test included fifty verified arc starts.

Here are the products and settings used:

**Wire / Flux combination:**

- Lincolnweld® L-61® electrode (5/32 in. (4.0 mm) dia.)
- Lincolnweld® 960 flux

**Mode Settings**

- AC 25% balanced wave
  This setting requires the Power Wave® AC/DC 1000® SD to deliver wire feed speeds near the upper end of the mode settings for a given current and electrode.

**Procedural Settings**

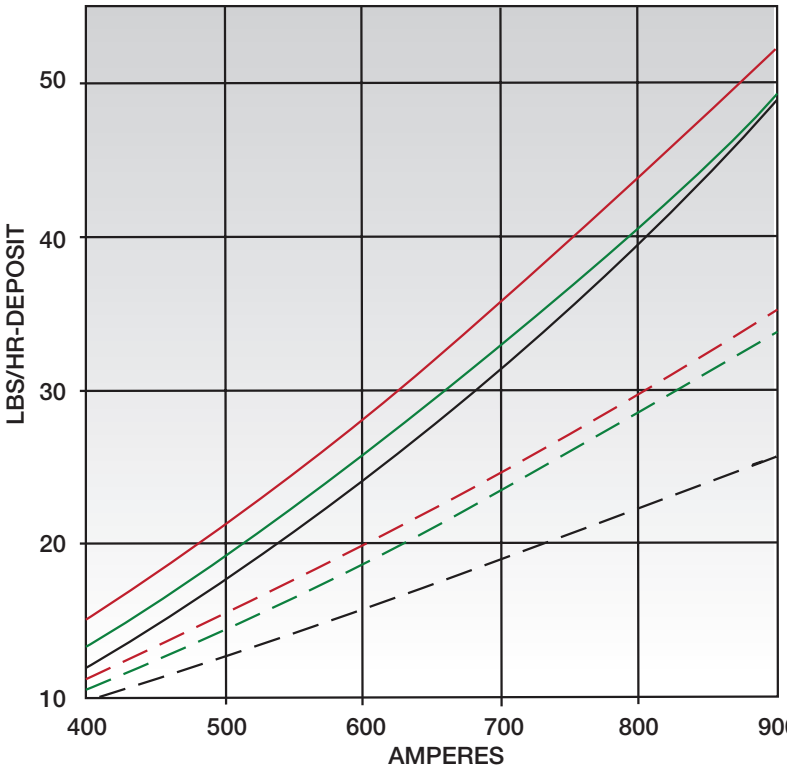
- 794 amperes
- 42 volts
- Reference wire feed speed, 137 in/min.
- 5 in. (127 mm) Electrical Stickout

Throughout these tests, arc striking was observed to be exceptionally robust, clean, stable and repeatable when using the Power Wave® AC/DC 1000® SD.

## Deposition Rate Curves

The following Figure 2 plots deposit rate vs. amperage or selected waveforms, electrode size and ESO.

**5/32 in. (4.0 mm) Diameter Submerged Arc Electrode Deposit Rates - Lbs./Hr**
**1.25 in. (31.75 mm) CTWD and 5 in. (127mm) CTWD**




LEGEND

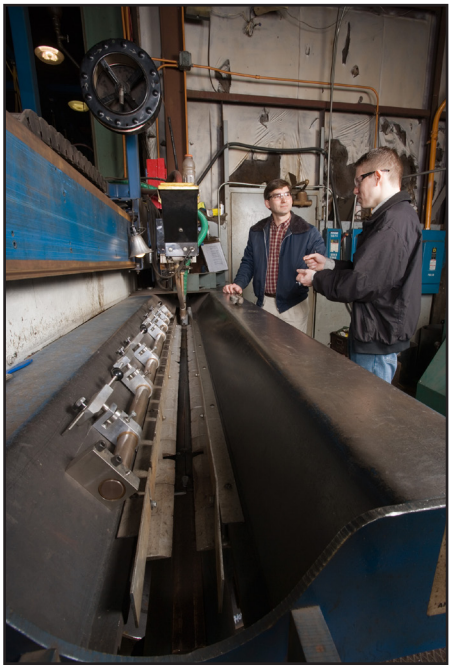
| | |
|---|---|
| Solid Lines: | 5/32 in. (4.0 mm) dia. electrode @ 5 in. (127 mm) CTWD. |
| Dash Lines: | 5/32 in. (4.0 mm) dia. electrode @ 1.25 in. (31.75 mm) CTWD. |
| Black: | DC+, constant current. |
| Green: | AC balanced square wave. |
| Red: | AC 25% balanced square wave. |

NOTE: Curves are not applicable below 400 amperes. Curves for 5 in. (127 mm) CTWD slightly skewed at 900 amperes and not valid over 900 amperes.

Figure 2

## Conclusion

- The Power Wave® AC/DC 1000® SD is very well suited for use with extended electrical stickout (EESO) which can make a major contribution to increasing submerged arc welding productivity.
- EESO is very well suited to welds requiring large fill volumes to produce the weld.
- ESO does not reduce penetration. Penetration is a function of current and keeping the arc on the weld joint at the leading edge of the weld puddle. As shown in the enclosed fillet weld examples, there is ample root penetration.
- ESO may be a useful way to reduce heat input where this is desired yet not sacrifice deposition rate.
- The use of ESO is compatible with the Power Wave® AC/DC 1000® SD waveforms. The AC 25% balanced waveform very closely approaches the deposition rates of DC- polarity operation but without the problems that can be encountered with DC- welding.
- The use of ESO can be a very effective way to fully utilize the capacity of the Power Wave® AC/DC 1000® SD.



## Submerged Arc Equipment System

**Increase your productivity by up to 100% over traditional systems.**

- **Power Wave® Process Control** – Gain complete control over the welding process, including polarity switching at the touch of a button.
- **Complete Configuration Flexibility** – Parallel up to 3 machines as needed for up to 6 independent arcs, resulting in greater output.
- **Connect Anywhere in the World** – One model for all of your global operations. (380-575 VAC, 50/60 Hz voltage input)
- **Outstanding Efficiency and Power Factor Correction (Up to 95%)** – Inverter-based design saves energy and reduces phase imbalance.
- **Severe-Duty Design** – For shop or field applications. IP23 Rated.
- **Production Monitoring™ 2** – Track equipment usage, store weld data and configure limits to assist in welding efficiency analysis.
- **True Energy™** – Measures, calculates and displays instantaneous energy in the weld for critical heat input calculations.
- **Applications** – Documented operational procedures for hundreds of applications.


Power Wave® AC/DC 1000® SD


MAXsa™ 10 Controller

NEXTWELD®

### WHAT IS NEXTWELD®?

*Through our commitment to extensive research and investments in product development, Lincoln Electric has established an industry benchmark for applying technology to improve the quality, lower the cost and enhance the performance of arc welding processes. Advancements in power electronics, digital communications and Waveform Control Technology® are the foundation for many of the improvements.*

*NEXTWELD® brings you a series of Process, Technology, Application and Success Story documents. NEXTWELD® explains how technologies, products, processes and applications are linked together to answer the important questions that all businesses face:*

- *How can we work faster, smarter, more efficiently?*
- *How can we get equipment and people to perform in ways they've never had to before?*
- *How do we stay competitive?*

*Ask your Lincoln Electric representative how to improve the flexibility, efficiency and quality of your welding operations to reduce your cost of fabrication.*



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