

THE FULL SOLUTION FOR SUBMERGED ARC WELDING



www.lincolnelectric.eu

LINCOLN[®]
ELECTRIC
THE WELDING EXPERTS[®]

GLOBAL LEADER FOR SUBMERGED ARC WELDING **KNOWN WORLDWIDE** FOR QUALITY, PERFORMANCE AND PRODUCTIVITY



11 000 Employees worldwide

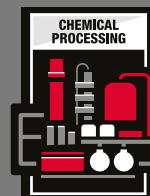
325+ Global R&D Team

125 Years of experience

38 Solution Centers

3.0 Billion USD revenue

SUBMERGED ARC WELDING FOR EVERY INDUSTRY



TECHNICAL EXPERTISE · PRODUCTIVITY SOLUTIONS
GLOBAL APPLICATION SUPPORT



[GOTO WEBPAGE](http://www.lincolnelectric.eu)

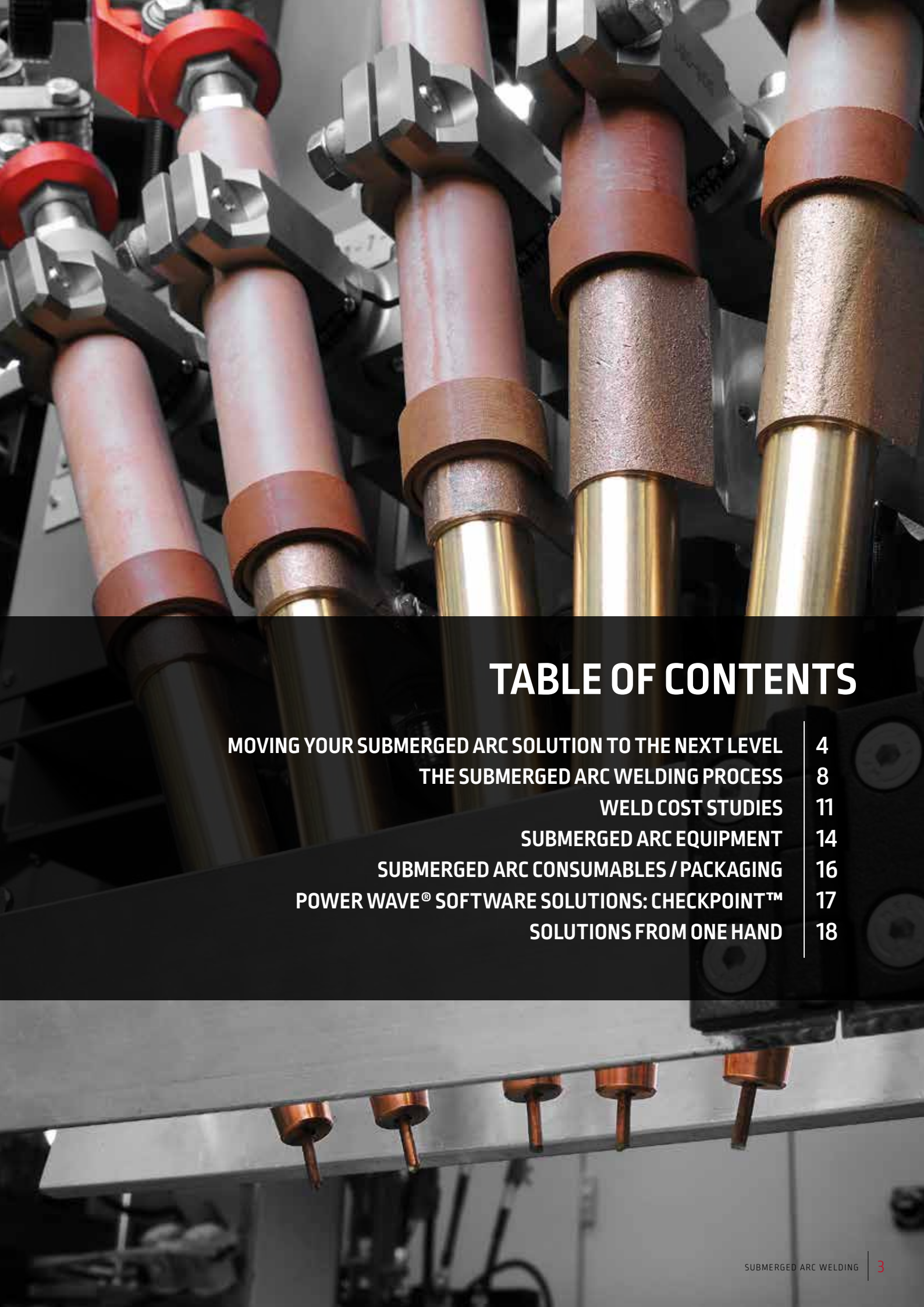


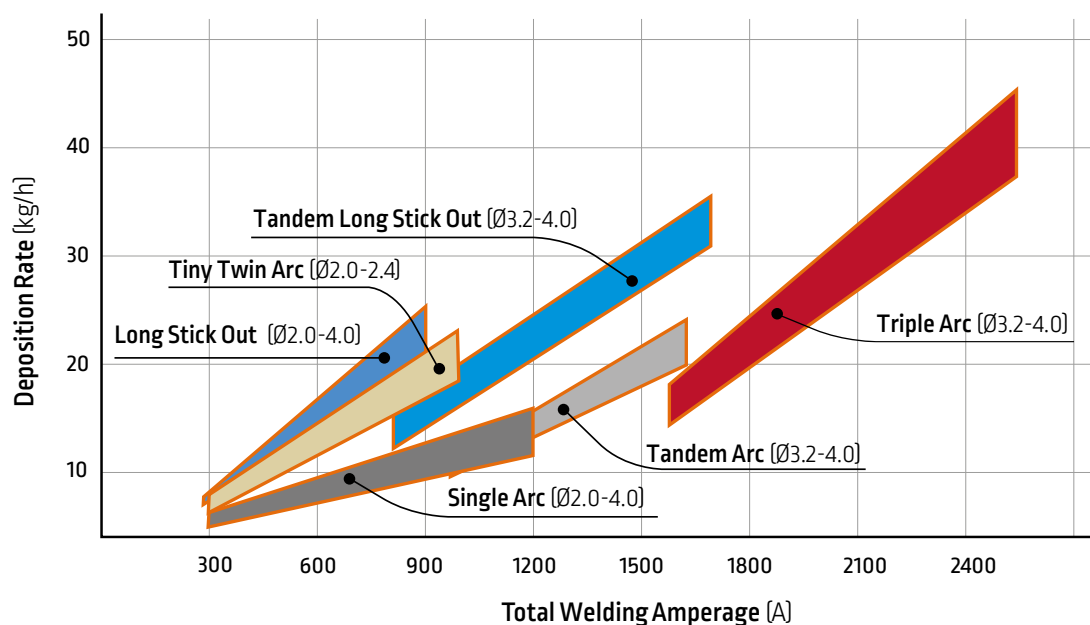
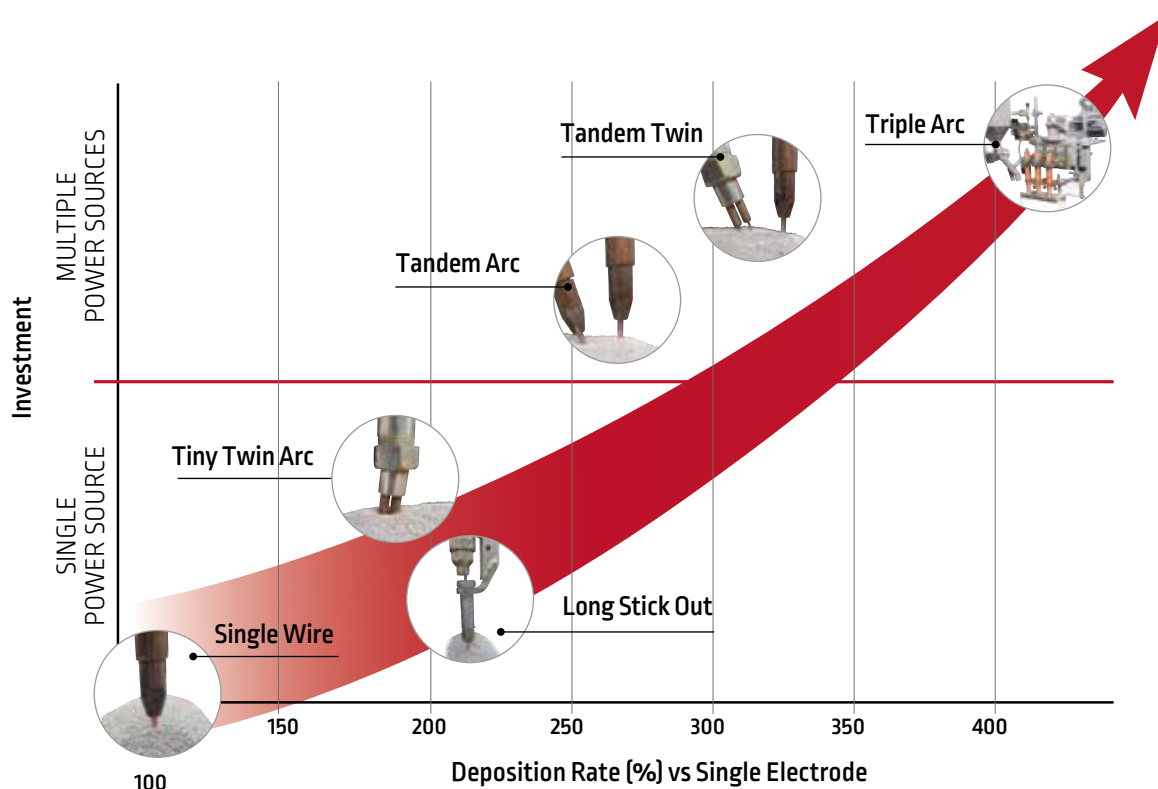
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MOVING YOUR SUBMERGED ARC SOLUTION TO THE NEXT LEVEL

- High quality welding results
- Excellent bead appearance
- Highest deposition rates
- Deep penetration
- Increased productivity

Lincoln Electric is the submerged arc process specialist. Together we will develop the best solution while maximizing your savings through highest deposition rates, highest quality and optimized parameters with your actual equipment and potential investments. Rate yourself on the next graph and let's move together to the next step.



MILD STEEL WIRE DEPOSITION RATES IN SUBMERGED ARC WELDING

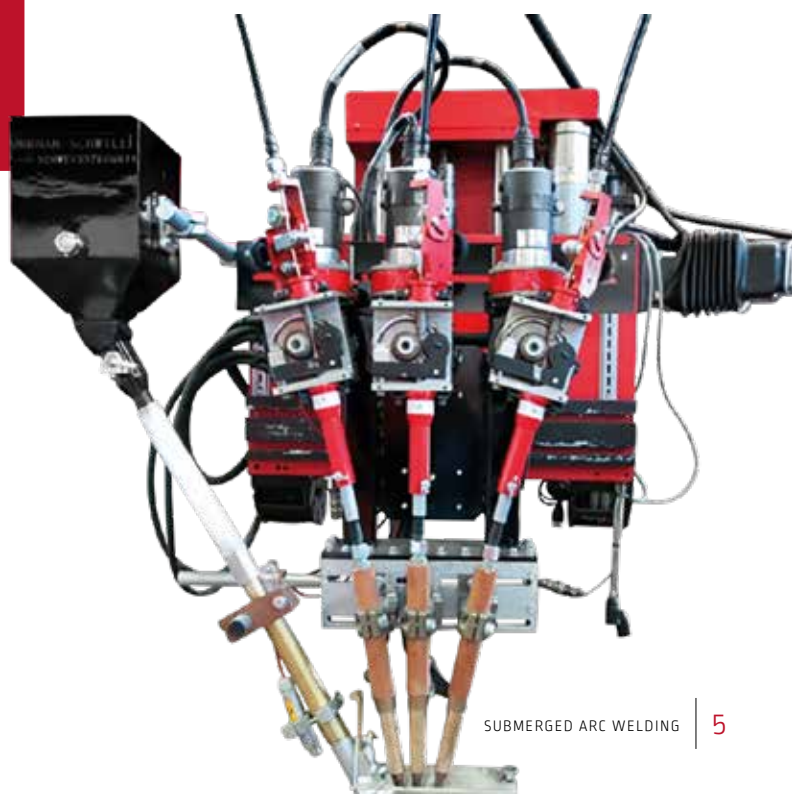
Average Deposition Rate in (kg/h)
Improvement versus standard Single Arc in [%]

		DC+		AC	
		Standard Stick Out	Long Stick Out	Standard Stick Out	Long Stick Out
Single Arc	Single Wire 4.0 mm	6.5 kg/h	10.0 kg/h +54%	8.0 kg/h +23%	15.0 kg/h +130%
	Tiny Twin Arc 2 x 2.0 mm	9.6 kg/h +48%	—	13.8 kg/h +112%	—
		DC+/AC		AC/AC	
		Standard Stick Out	Long Stick Out	Standard Stick Out	Long Stick Out
Multiple Arcs	Tandem Arc 2 x 4.0 mm	18.7 kg/h +188%	23.5 kg/h +262%	20.7 kg/h +218%	29.0 kg/h +346%
	Tandem Twin 4.0 + 2 x 2.0 mm	23.2 kg/h +256%	—	26.0 kg/h +300%	—
	AC/AC/AC				
	Standard Stick Out				
	Triple Arc 3 x 4.0 mm	32.0 kg/h +392%			

Lincoln Electric supports you to select:

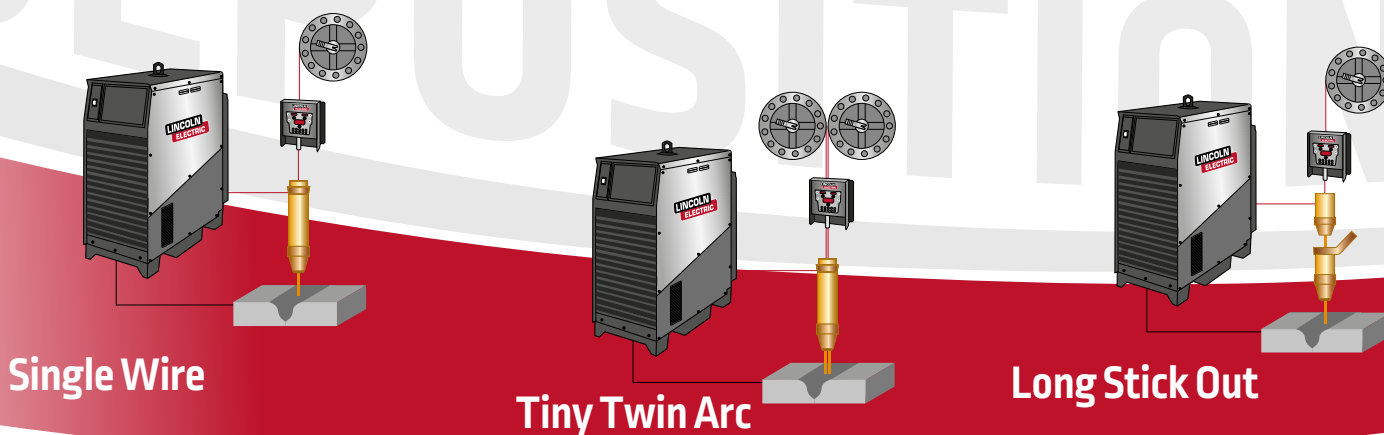
- Optimum process
- Ideal parameters
- Consumables that guarantee the required mechanical properties customized to your application

GO FOR
NEXT
STEP



DEPOSITION RATES – SINGLE POWER SOURCE

The single power source configuration panel



- Standard platform
- Easy to upgrade
- Deposition rate up to 10 kg/h

1 – Power source
1 – Wire feeder
1 – Wire

- Low additional investment
- To be used over 700 A
- High deposition rate and high speed weld
- To be used on fillet or filling weld
- Reduced penetration
- Deposition rate up to 20 kg/h

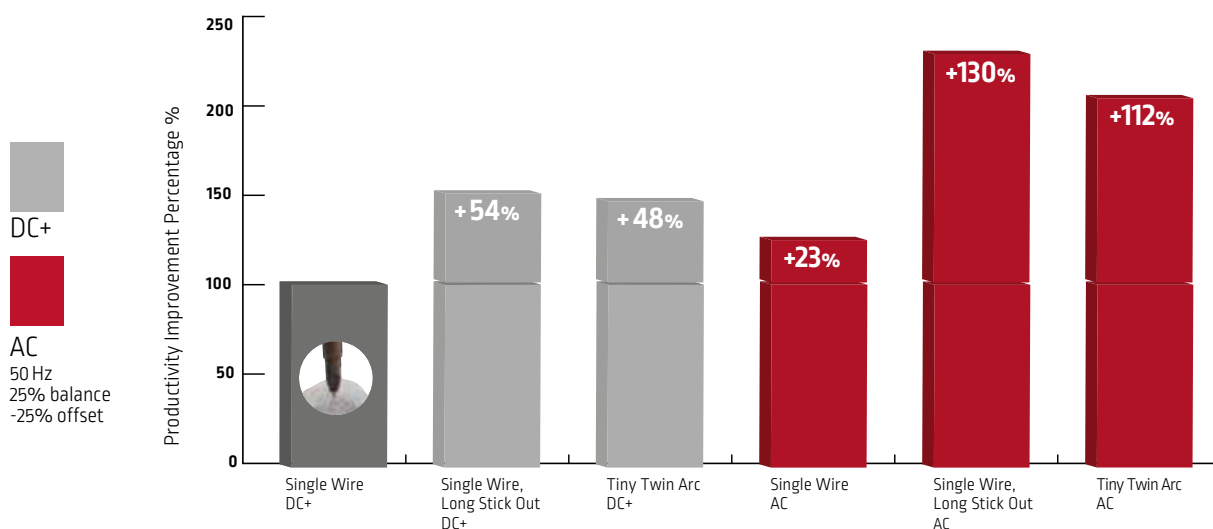
1 – Power source
1 – Wire feeder
2 – Wire
1 – Drive roll kit

- Very low additional investment
- High deposition rate
- Low heat input (less distortion)
- Flux / wire ratio reduction
- Deposition rate up to 30 kg/h
- Recommended with Power Wave® AC/DC 1000® SD

1 – Power source
1 – Wire feeder
1 – Wire
1 – Long Stick Out kit

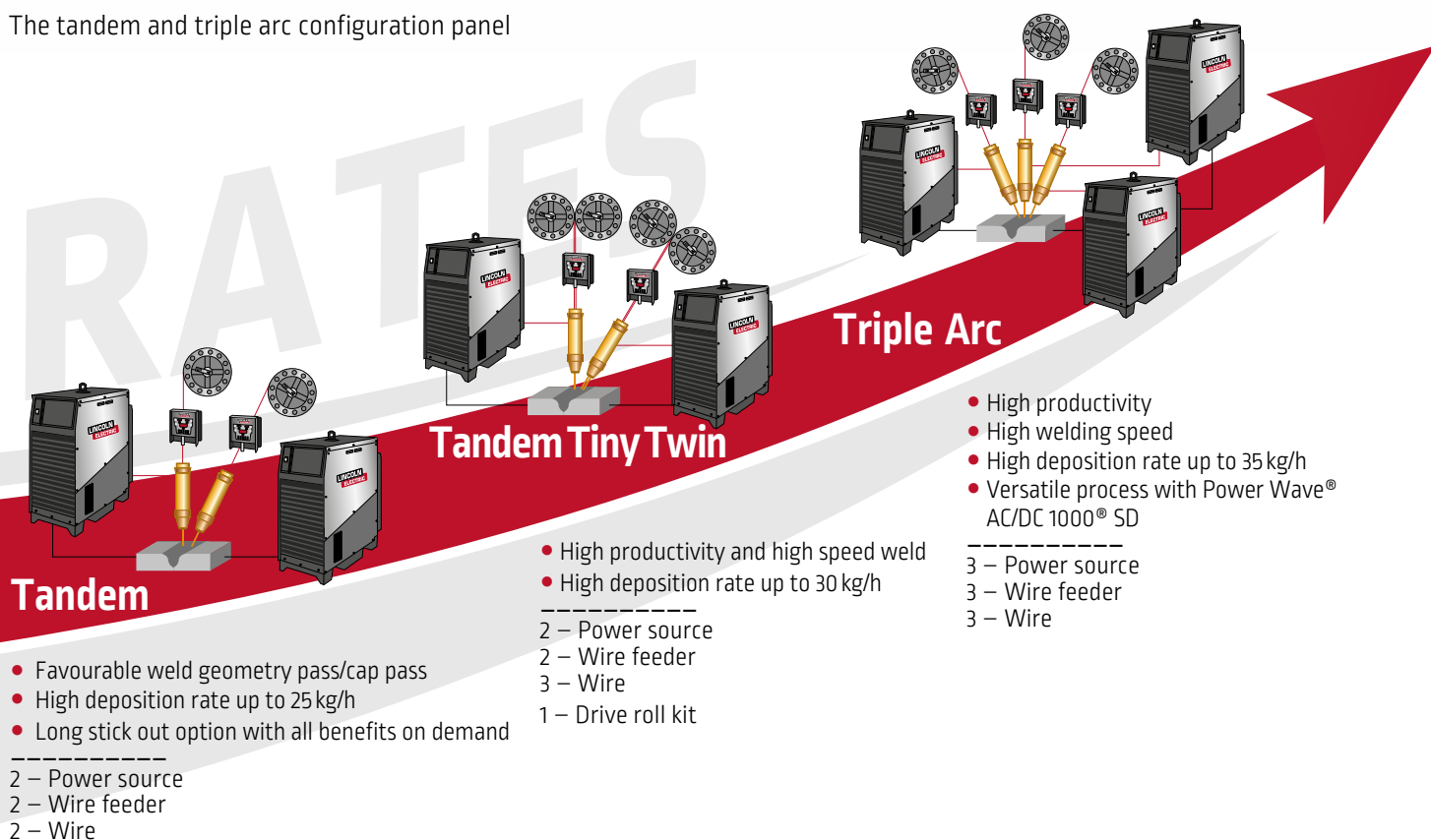
TYPICAL STANDARD DEPOSITION RATES FOR SINGLE POWER SOURCE

DC+			AC		
Single Wire 4.0 mm		Tiny Twin Arc 2.0 x 2.0 mm	Single Wire 4.0 mm		Tiny Twin Arc 2.0 x 2.0 mm
Standard Stick Out	Long Stick Out	Standard Stick Out	Standard Stick Out	Long Stick Out	Standard Stick Out
Typical Deposition Rate					
6.5 kg/h	10.0 kg/h	9.6 kg/h	8.0 kg/h	15.0 kg/h	13.8 kg/h
Improvement vs. Single Wire 4.0 mm					
100%	154%	148%	123%	230%	212%



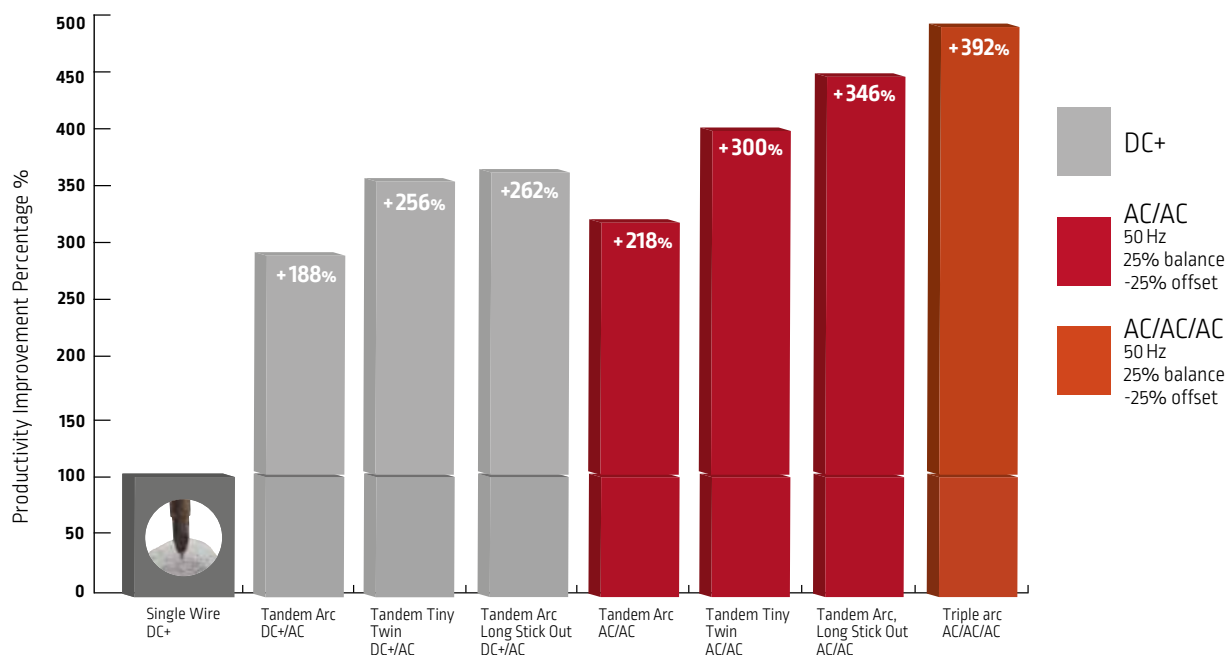
DEPOSITION RATES – MULTIPLE POWER SOURCES

The tandem and triple arc configuration panel



TYPICAL STANDARD DEPOSITION RATES FOR MULTIPLE POWER SOURCES

Single wire 4.0 mm	DC+/AC			AC/AC			AC/AC/AC
	Tandem Arc	Tandem Tiny Twin	Tandem Arc + Long Stick Out	Tandem Arc	Tandem Tiny Twin	Tandem Arc + Long Stick Out	Triple Arc 3 x 4.0 mm
Typical Deposition Rate							
6.5 kg/h	18.7 kg/h	23.2 kg/h	23.5 kg/h	20.7 kg/h	26.0 kg/h	29.0 kg/h	32.0 kg/h
Improvement vs. Single Wire 4.0 mm							
100%	288%	356%	362%	318%	400%	446%	492%





THE SUBMERGED ARC WELDING PROCESS

The arc being shielded and hidden under the flux, high current density can be considered with the following benefit:

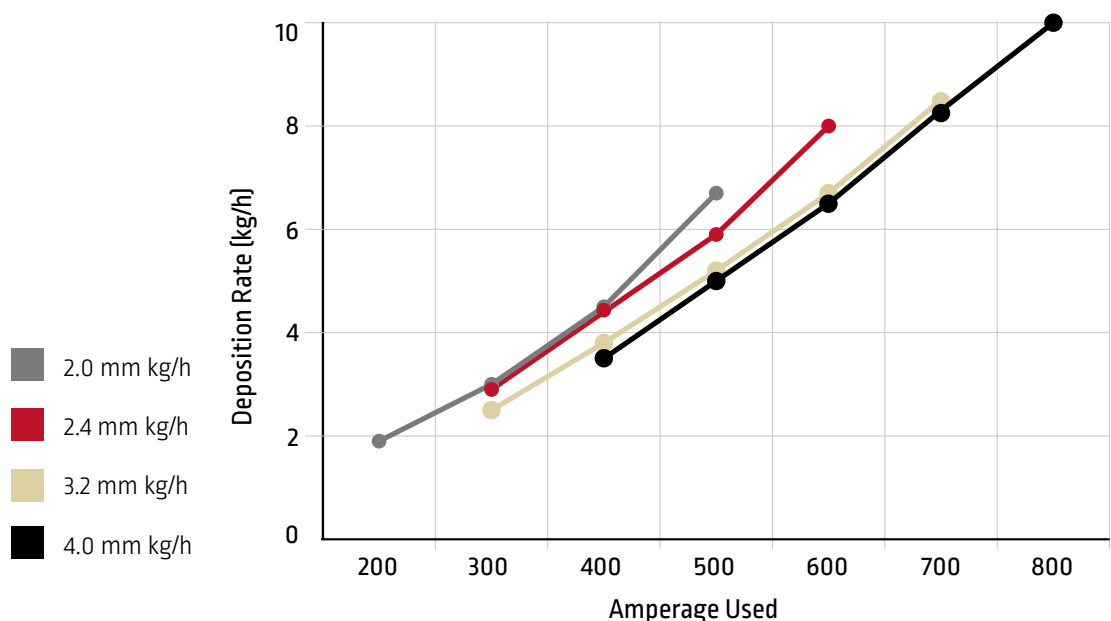
- Operator protection from arc ray and heat radiation
- High deposition rate and high quality welds
- Versatile welding process with combination of wire diameter, flux type, single or multiple electrodes, welding current wave shape and welding mode

WELDING PARAMETERS (VARIABLES)

WIRE DIAMETER/AMPERAGE

The submerged arc wire standard portfolio includes different wire sizes, mainly between 2.0 and 4.0 mm wire diameter. The choice of wire size is made in accordance with the welding procedure parameters in order to maximize the current density and increase the melt off rate, without exceeding the wire current carrying capacity as shown in the following table.

		Amperage Used						
Wire Diameter		200	300	400	500	600	700	800
2.0 mm	kg/h	1.9	3.0	4.5	6.7			
2.4 mm	kg/h		2.9	4.4	5.9	8.0		
3.2 mm	kg/h		2.5	3.8	5.2	6.7	8.5	
4.0 mm	kg/h			3.5	5.0	6.5	8.3	10.0



POLARITY

In most of the submerged arc applications it is possible to work in DC current with the electrode being either positive or negative.

Thanks to Lincoln Electric Waveform Control Technology® embedded in the new Power Wave® AC/DC 1000® SD power source and the new MAXsa® Controllers and Feeders, we can now take over the full area between DC+ and DC-.

DC +

- Most common mode
- Deep penetration and stable arc

DC-

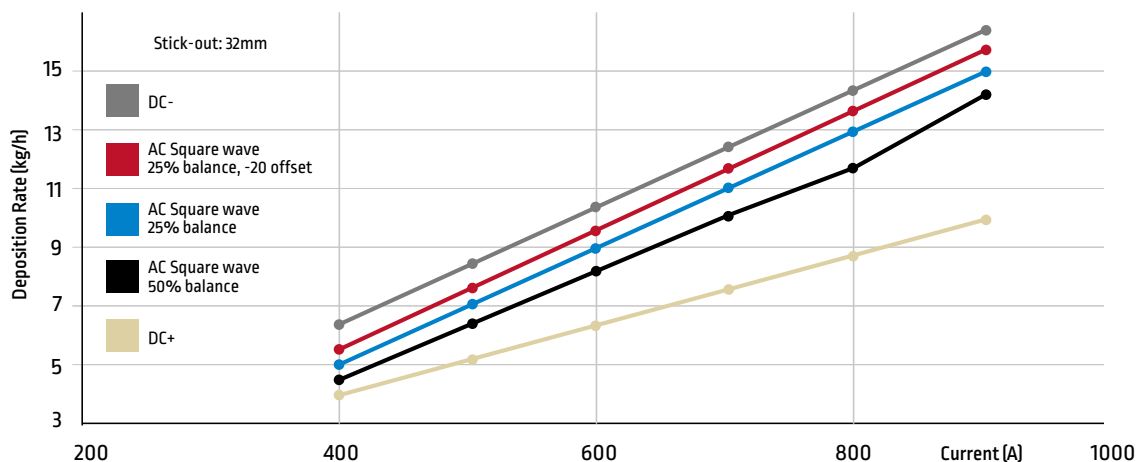
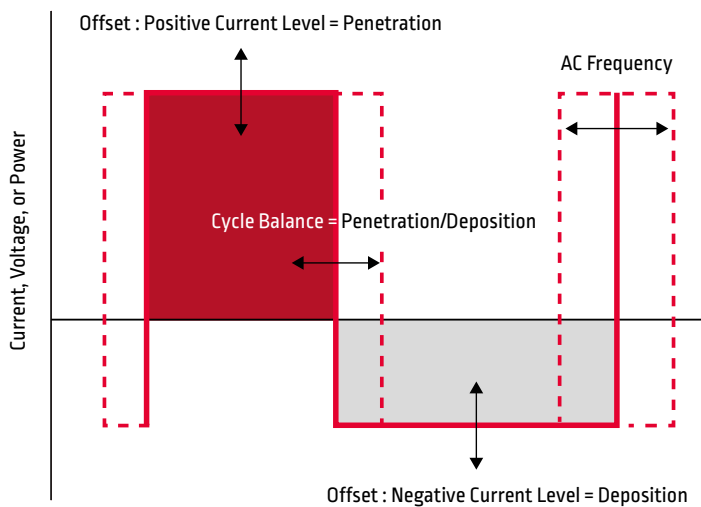
- Improves deposition rate (25%)
- Limits penetration
- Limited arc stability

AC

- A compromise between the two DC modes
- The optimum choice with Power Wave® AC/DC 1000® SD

Waveform Control Technology® capability provides precise control over:

- Frequency (Number of switch per second from positive to negative polarity)
- Balance (Percentage of time in the positive polarity portion of one cycle)
- Offset (Positive/Negative Amplitude)



ELECTRICAL STICK OUT

Electrical Stick Out setting:

The electrical stick out or CTWD (contact tip to work distance) is the distance set between the contact tip end and the work piece. The stick out needs to be kept constant along the weld if consistent results are expected for the welding behavior and penetration.

The Long Stick Out variant:

Taking benefit of the Power Wave® technology, the long stick out variant is now a reliable option for a number of applications.



 WATCH VIDEO

Unmatched Productivity Increase

- Increase deposition rate without changing the process
- Significant reduction of heat input possible

Complete Control

- Power Wave® technology eliminates arc striking issues 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



HEAT INPUT

HI = Heat Input [kJ/cm]

A = Current [A]

V = Voltage [V]

v = Travel Speed [cm/min]

$$HI = 0.06 \times \frac{A \times V}{v}$$

The heat input will affect the mechanical properties of the deposited metal as well as the base material in the heat affected zone. It is also a key parameter for the distortion of the weld assembly. As an example, a target at 20 kJ/cm for single arc procedure on non and low alloy grade is a good start. With the Power Wave® AC/DC 1000® SD, the heat input can be optimized and tailored as needed.

WELD COST STUDIES

LINCOLN SUPPORT IN PRODUCTIVITY IMPROVEMENT

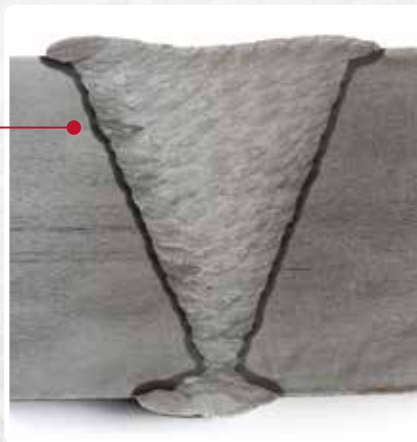
As per our previous parameters setting range description, the submerged arc process offers a lot of opportunities for productivity improvements. From the procedure adjustment to the hard automation investment, it is our philosophy to partner with the customer to achieve the highest savings combined with an optimum ROI (return on investment).

Improving productivity in the workshop should be considered from many aspects:

WELD PREPARATION

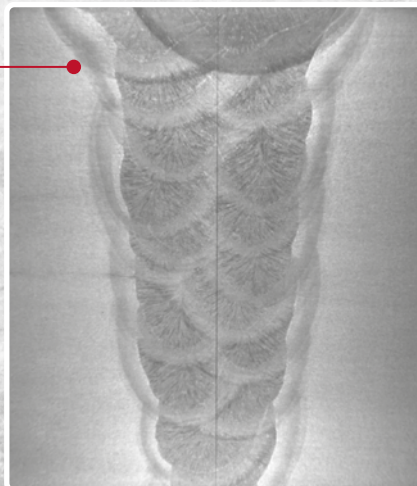
V, X and K joint

- The included angle ranges between 45° and 60°
The narrower angle is used when the top of the preparation can be reached in one pass



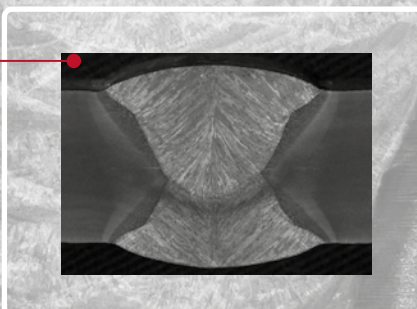
Heavy plates

- Combined preparation also called a compound bevel is used to limit the groove area and guarantee penetration
 - 60° angle at the bottom
 - 5° to 15° above as soon as the bevel side distance exceed 12 mm
 - Machining and seam tracking system is mandatory



Double side welds

- Symetric preparations are always more effective than asymmetric grooves
- Up to 25 mm, it is possible to use the two run technique (1 pass each side in tandem)



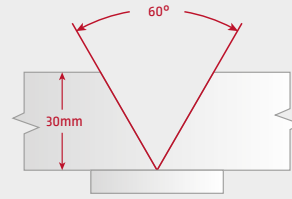
WELD COST STUDY - SINGLE POWER SOURCE EXAMPLE

APPLICATION

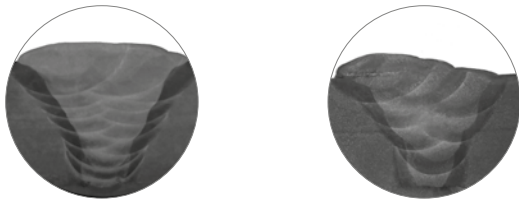
Labour cost*: 60 €/h

Weld length: 10 000 m

Consumables: Lincolnweld® 860 / L-61 wire combination



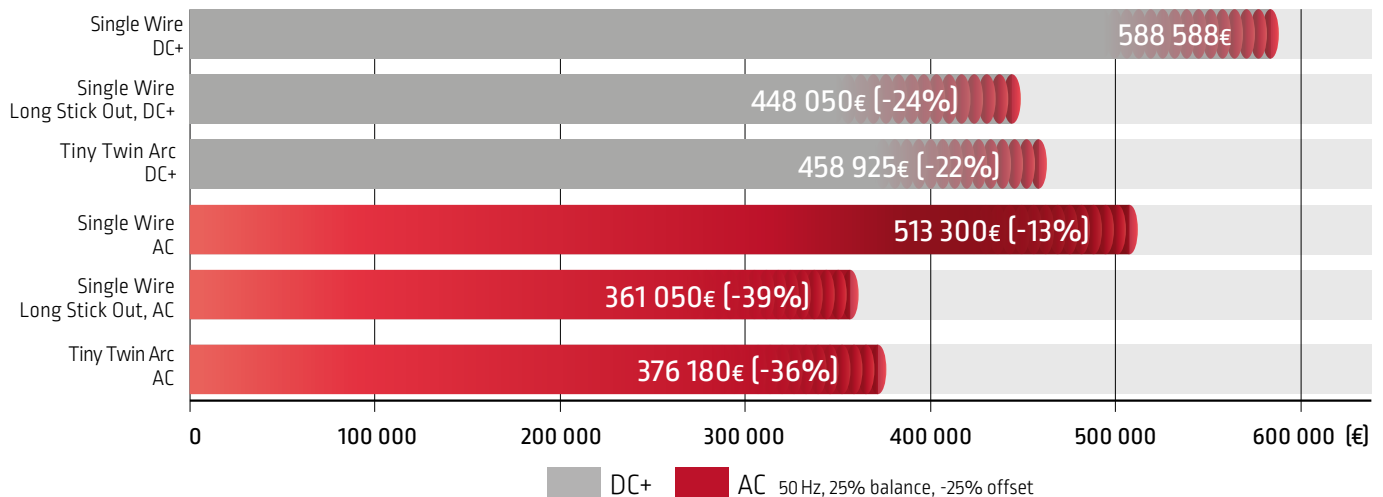
Weld metal
per m = 4.35 kg
Consumable cost
per m = 18.70 €

			DC+			AC**		
			Single Wire		Tiny Twin Arc	Single Wire		Tiny Twin Arc
			30 mm Stick Out	Long Stick Out	25 mm Stick Out	30 mm Stick Out	Long Stick Out	25 mm Stick Out
PROCESS	Electrical parameters	Amperage	550	550	800	550	550	800
		Voltage	29	29	31	31	31	33
	Deposition rate	[kg/h]	6.5	10.0	9.6	8.0	15.0	13.8
	Welding speed	[cm/min]	42	65	65	42	65	65
	Heat input	[kJ/cm]	23.0	15.0	23.0	24.0	16.0	24.0
COST STUDY FOR 10 000 METERS OF WELD								
CONSUMABLE COST	Weld metal cost	[€]	187 000					
PRODUCTION COST	Welding time	[h]	6 692	4 350	4 531	5 438	2 900	3 152
	Time saving	[h]	-	-2 342	-2 161	-1 255	-3 792	-3 540
	Labour cost*	[€]	401 538	261 000	271 875	326 250	174 000	189 130
	Labour saving	[€]	-	-140 538	-129 663	-75 288	-227 538	-212 408
TOTAL COST	Total cost	[€]	588 588	448 050	458 925	513 300	361 050	376 180
	Total cost saving			-24%	-22%	-13%	-39%	-36%

* Machine cost including one operator

** AC = 50 Hz, 25% balance, -25% offset

Total Welding Cost for 10 000 m of Weld



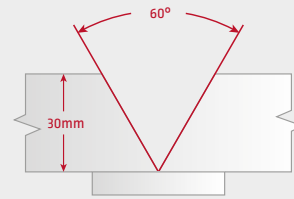
WELD COST STUDY – MULTIPLE POWER SOURCE EXAMPLE

APPLICATION

Labour cost*: 60 €/h

Weld length: 10 000 m

Consumables: Lincolnweld® 860 / L-61 wire combination



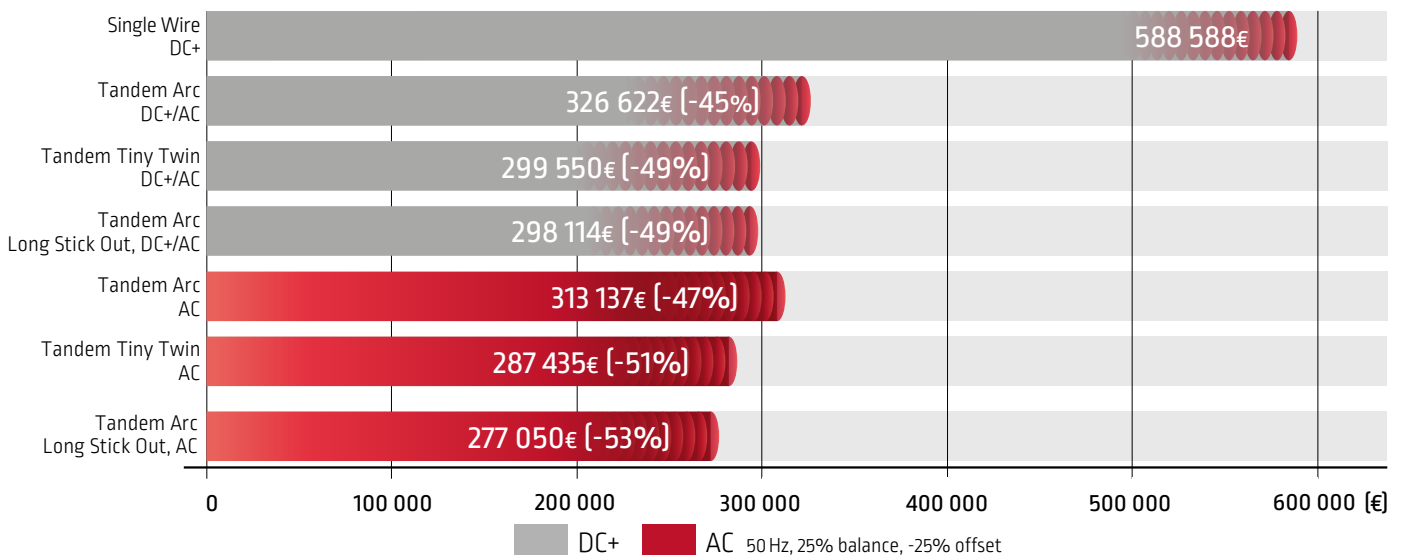
Weld metal
per m = 4.35 kg
Consumable cost
per m = 18.70 €

			DC +	DC +/AC*			AC/AC**		
			Single Wire	Tandem Arc	Tandem Tiny Twin	Tandem Arc + Long Stick Out	Tandem Arc	Tandem Tiny Twin	Tandem Arc + Long Stick Out
			30 mm Stick Out	30 mm Stick Out	25 mm Stick Out	125 mm Stick Out	30 mm Stick Out	25 mm Stick Out	125 mm Stick Out
PROCESS	Electrical parameters	Amperage	550	750/650	850/750	750/650	750/650	850/750	750/650
		Voltage	29	30/32	32/33	30/32	32/34	33/34	32/34
	Deposition rate	[kg/h]	6.5	18.7	23.2	23.5	20.7	26.0	29.0
	Welding speed	[cm/min]	42	100.0	130.0	120.0	100.0	130.0	120.0
	Heat input	[kJ/cm]	23.0	26.0	24.0	21.0	26.0	25.0	21.0
COST STUDY FOR 10 000 METERS OF WELD									
CONSUMABLE COST		Weld metal cost	[€]	187 000					
PRODUCTION COST	Welding time	[h]	6 692	2 326	1 875	1 851	2 101	1 673	1 500
	Time saving	[h]	-	-4 366	-4 817	-4 841	-4 591	-5 019	-5 192
	Labour cost*	[€]	401 538	139 572	112 500	111 064	126 087	100 385	90 000
	Labour saving	[€]	-	-261 966	-289 038	-290 475	-275 452	-301 154	-311 538
TOTAL COST	Total cost	[€]	588 588	326 622	299 550	298 114	313 137	287 435	277 050
	Total cost saving			-45%	-49%	-49%	-47%	-51%	-53%

* Machine cost including one operator

** AC = 50 Hz, 25% balance, -25% offset

Total Welding Cost for 10 000 m of Weld



SUBMERGED ARC EQUIPMENT

Digital Power Source

Power Wave® AC/DC 1000® SD

Increase Productivity, Quality and Flexibility



Output



Input



[GO TO WEB PAGE](#)

Digital Wire Feeders

MAXsa® 10 Controller

ArcLink® enabled Controller for
Power Wave® AC/DC 1000® SD Systems



Output



Input



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MAXsa® 22 Feed Head

Submerged Arc Hard Automation Wire Drive
for Power Wave® AC/DC 1000® SD Systems



Output



Input



[GO TO WEB PAGE](#)



Output



Input



Idealarc® AC-1200

Automatic Submerged Arc Welding Power Source



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AC-1200



Output



Input



Idealarc® DC-1000 Idealarc® DC-1500

Industrial DC Multi-Process Welders



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DC-1000



GO TO WEB PAGE
DC-1500

NA-3, NA-4 & NA-5 Control & Heads

Automatic Welding Systems



Output



Input



GO TO WEB PAGE
CONTROLLERS

SUBMERGED ARC CONSUMABLES



[GO TO WEB PAGE](#)

Lincoln Electric is proud to offer a complete solution of equipment and consumables in order to deliver the best quality and most economical weld for any application. Ask your Lincoln Electric representative for the next step.

Application	Fluxes	Wires
Mild Steel	761, 780, 781, 782, 839, 842-H	L-60, L-61, LNS 135, L-50M
Low Alloy	8500, 860, 888, 960, 980, P230, P240	LNS 140A, LNS 150, LNS 151, LNS 160, LNS 162, LNS 163, LNS 164, LNS 165, LNS 168
High Alloy (SS+Ni)	P2000, P2007, P2000S	LNS 304L, LNS 304H, LNS 307, LNS 309L, LNS 316L, LNS 318, LNS 347, LNS 4455, LNS 4462, LNS 4500, LNS Zeron® 100X, LNS NiCro 60/20, LNS NiCro 70/19, LNS NiCro Mo 60/16

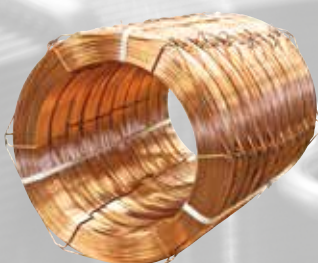
PACKAGING

SUBMERGED ARC FLUX AND WIRES



25 kg Spool

VCI packaging for optimum corrosion protection during transportation and storage



100 kg Coil

High capacity packaging for column/boom applications, optimum for multi-wire applications (tandem/triple arc)



300 kg Spool
Wooden reel



1000 kg Coil
Liftable



Speed-Feed® Drum



Accu-Trak® / Speed-Feed® Drums
600 kg / 1000 kg



25 kg Bag

- Standard plastic
- Moisture resistant Sahara ReadyBag™



1000 kg Bulk Bag

**OTHER
PACKAGING
AVAILABLE
ON REQUEST**

CHECKPOINT™

With the Power Wave® AC/DC 1000® SD, store your weld data in the cloud and access it on almost any device.

- **Traceability/Scanning**

Use the CheckPoint™ mobile app to scan barcodes for operator, consumable ID and part serial numbers. All scans are correlated with the weld data transmitted by the welder. Includes bluetooth integration for industrial barcode scanners

- **Simple System Management**

Determine who is authorized to view the data, analysis, documents and manuals specific to each welder through desktop and mobile devices

- **Cloud API**

Using the industry standard protocol O Data, CheckPoint™ delivers secure access to data by enterprise ERP systems, plant OEE systems, and maintenance applications



FREE LINCOLN SOFTWARE

Benefits

- **No software hassles**

No software to buy, install or upgrade with the standard edition: upgrades are automatic and instantaneous

- **Easy to activate**

Minimal or no IT investment required; just connect the welder to the internet and you are ready to go

- **Easy to use**

Log in anywhere at any time to view welder status and much more

- **Mobile device compatibility**

View on smart phones, tablets, laptops or desktops with any browser

- **Graphical interface**

View data in an intuitive dashboard view that provides a Pulse™ on your welding operations at a glance

- **Security you can count on**

Your data is protected with physical security, encryption, user authentication and more

- **Data aggregation**

With a global view of all of your welding equipment, you can benchmark your facilities

- **Exporting**

Export data and reports in various formats for offline analysis

- **No Software to buy, install or upgrade with standard edition**

- **No additional hardware**

- **Just log in and start using it**

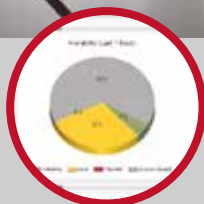


 **DOWNLOAD**



Alerts

Receive email notifications based on equipment conditions and wire consumption.



Production Monitoring

View live status of each welder and weld details.



Traceability

Satisfy reporting requirements by capturing audit trail data.

Always On™ and Pulse™ are trademarks of I/Gear Online, LLC

SOLUTIONS FROM ONE HAND



Uhrhan-Schwill
SCHWEISSTECHNIK
 A Lincoln Electric Company

PipeMills

Multi Arc, Sub Arc Technology

Global Leader
 in Longitudinal Pipe Welding
 and Leading Position
 in Spiral Pipe Welding

Critical Process Equipment

Strip Cladding
 complete solution

Narrow Gap Welding
 complete solution

YOUR NEXT POWER WAVE® DIGITAL APPLICATION

THE NEW DIMENSION IN STRIP CLADDING

70% Time and 40% Cost Saving

- Always Single Layer Solution
- High Speed Cladding Process

Homogeneous and Cleaner Chemistry

- < 5% Fe in Ni-625
- Improved Quality

Full Process Control

- State-of-the-Art Digital Hybrid 3D Z5 Controller
- Real Time Data Logging and Traceability

First Proven Single Layer High Speed Solution with Neutral Flux

- < 5% Fe in Ni-625
- Required Undiluted AWS Chemistry for Stainless Steel

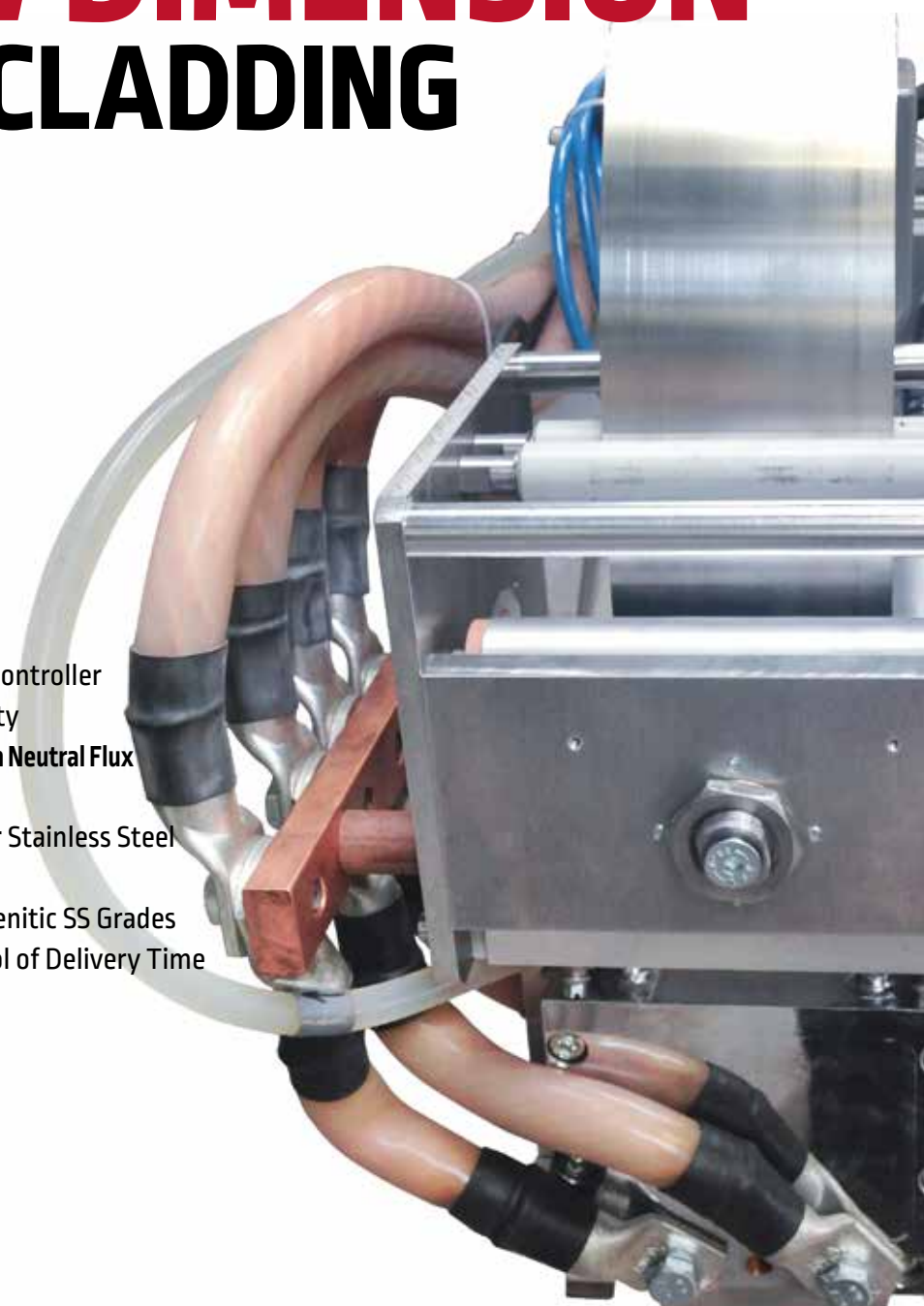
Reduction in Working Capital

- Single Stainless Steel Strip for All Austenitic SS Grades
- Faster Delivery of MCW and Full Control of Delivery Time

Instant Technical Service to Customer



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 [DOWNLOAD THE BROCHURE](#)



CUSTOMER ASSISTANCE POLICY

The business of The Lincoln Electric Company® is manufacturing and selling high quality welding equipment, consumables, and cutting equipment. Our challenge is to meet the needs of our customers and to exceed their expectations. On occasion, purchasers may ask Lincoln Electric for information or advice about their use of our products. Our employees respond to inquiries to the best of their ability based on information provided to them by the customers and the knowledge they may have concerning the application. Our employees, however, are not in a position to verify the information provided or to evaluate the engineering requirements for the particular weldment. Accordingly, Lincoln Electric does not warrant or guarantee or assume any liability with respect to such information or advice. Moreover, the provision of such information or advice does not create, expand, or alter any warranty on our products. Any express or implied warranty that might arise from the information or advice, including any implied warranty of merchantability or any warranty of fitness for any customers' particular purpose is specifically disclaimed.

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