
RAISE YOUR DEPOSITION RATE TO >40kg/h
HIGH PRODUCTIVITY WELDING SOLUTION
FOR THE OFFSHORE WIND INDUSTRY
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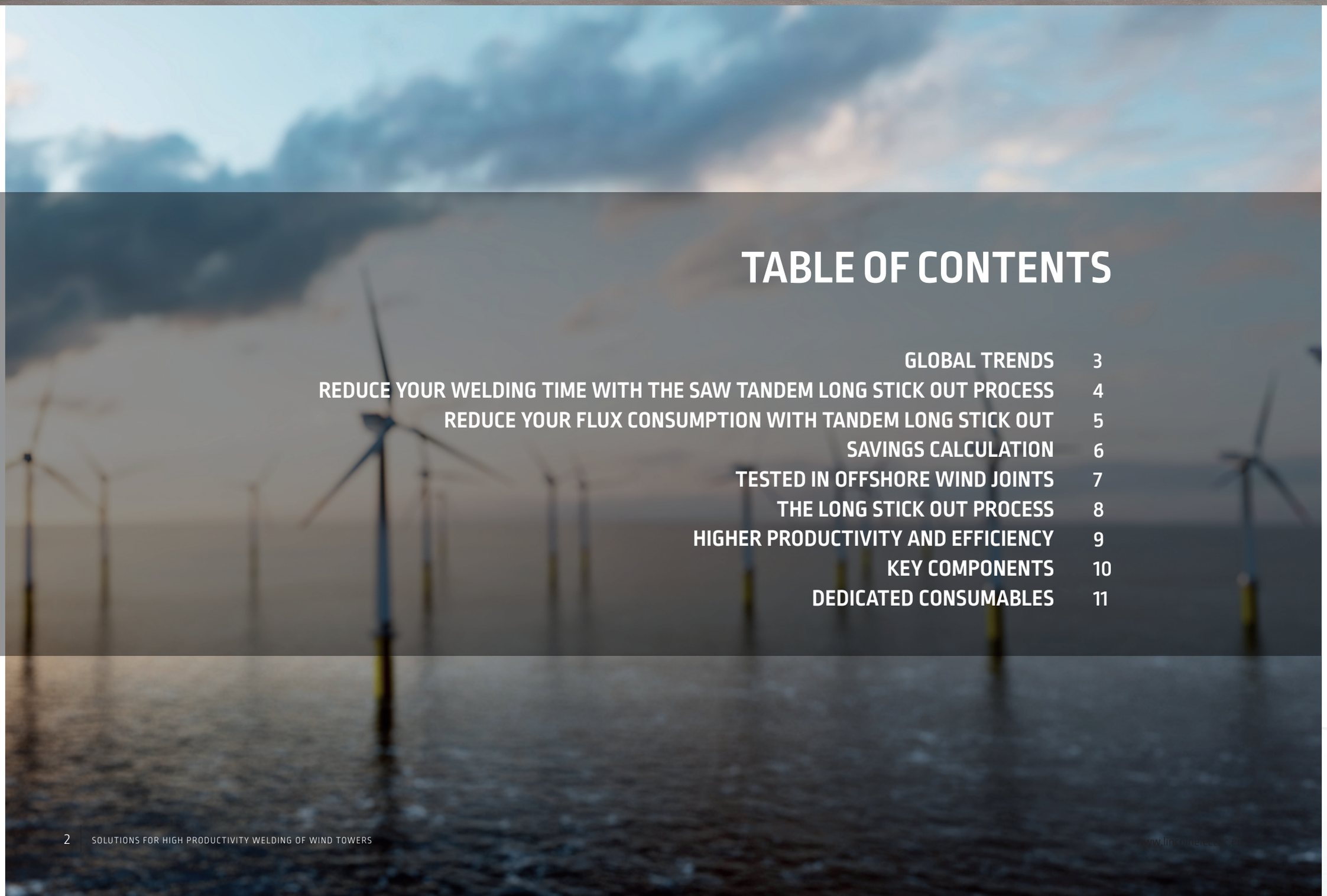
LINCOLN ELECTRIC



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GLOBAL TRENDS

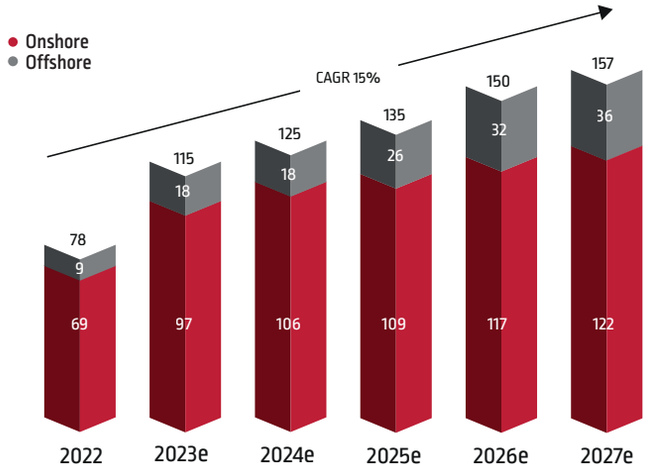
As the global wind industry focuses on solving the supply chain challenges ahead for the expansion of offshore and onshore wind, there are tremendous accomplishments already achieved. The transformation of steel into the key components of the energy transition is already well under way, supported by record new investment commitments.

Christopher L. Mapes
Chairman, President and
Chief Executive Officer,
Lincoln Electric

From new steel plant capacity, planned or already online, to pipe mills, shipyards and regional fabricators around the world, these new industry investments are driving one of the most rapid global industrialisation periods we have seen. The outcome of this process will enable the world to build and install turbines, towers and foundations (fixed-bottom and floating) of immense size, never before realised. With the race to wind turbines of 20+ MW accelerating, the offshore wind supply chain of the future will need to produce at elevated levels, higher than ever before. However, it is clear that the present levels of investment commitment across the entire supply chain still fall well short of what is required for the global industry to hit installed capacity targets.

As a key global supplier who supports the entire fabrication supply chain of assets and infrastructure, Lincoln Electric sees the global industry through a unique lens.

New installations outlook 2022-2026 (GW)



Source: GWEC, 2023

Key to unlocking the full capacity of the supply chain is innovation, together with new installation methods, designs and advanced technology that can drive the profitable success of the industry. Additionally, the continuous development of a highly skilled workforce will be critical, as well as the implementation of higher levels of automation solutions, which can reduce project hours and overall costs.

* Source: GLOBAL WIND REPORT 2023, https://gwec.net/globalwindreport2023/

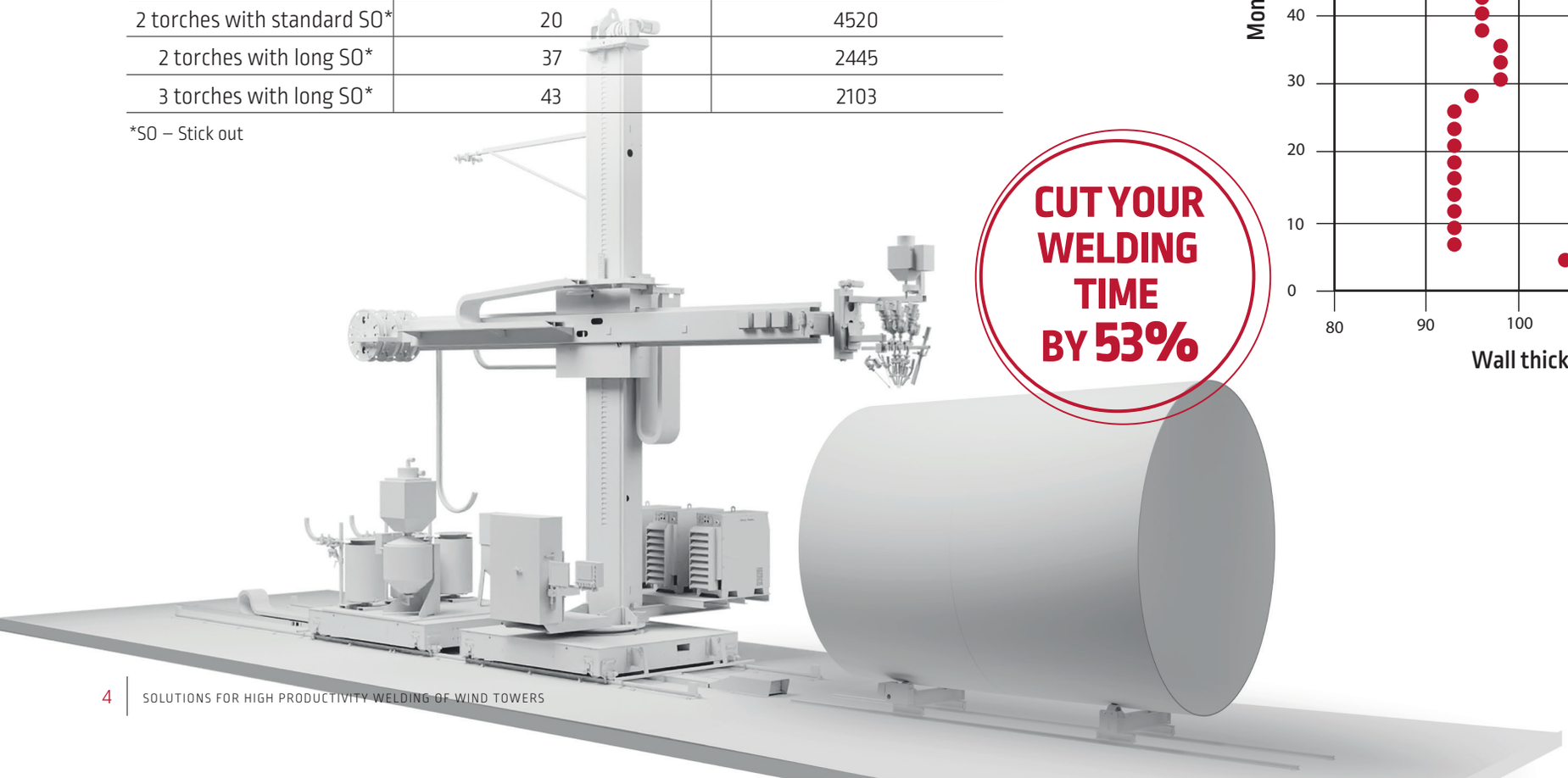
REDUCE YOUR WELDING TIME WITH THE SAW TANDEM LONG STICK OUT PROCESS

Off-shore Monopile

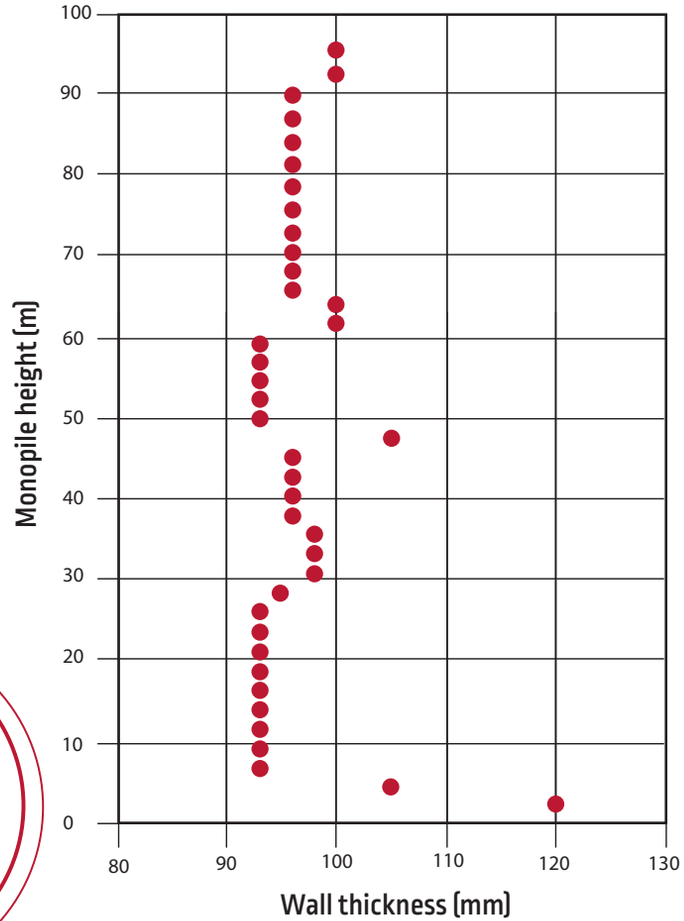
- Height: 96 m
- 12 m diameter at the base and 8,5 m at the top
- 90-120 mm wall thickness
- Special-back milled 16° U bevel

Tandem Process	Average Deposition Rate (kg/h)	Welding time per tower (h) using 60% operating factor
	Multi Run	
2 torches with standard SO*	20	4520
2 torches with long SO*	37	2445
3 torches with long SO*	43	2103

*SO – Stick out



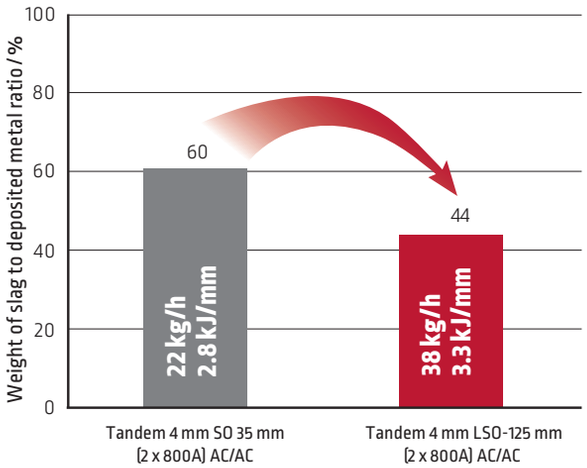
CUT YOUR WELDING TIME BY 53%



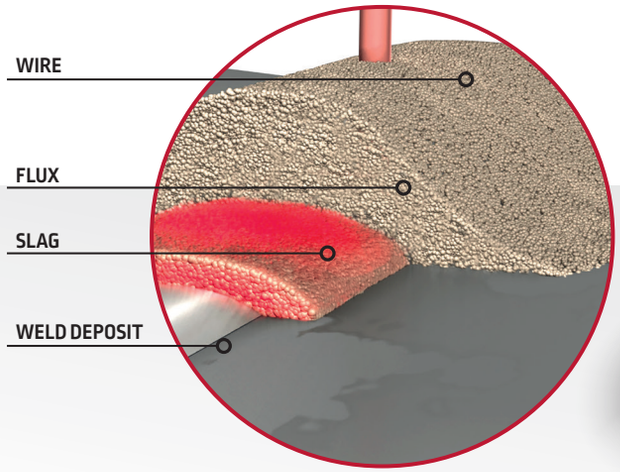
REDUCE YOUR FLUX CONSUMPTION WITH TANDEM LONG STICK OUT

- LSO increases the deposition rate and at the same time significantly reduces the flux consumed during welding
- Higher volumes of metal are deposited whilst the amount of slag produced is moderately increased
- Due to the difference in materials density the consumed flux to deposited metal ratio decreases

Slag to deposited weld metal ratio for Tandem std and Tandem LSO processes *



CONSUMPTION DECREASED BY 27%



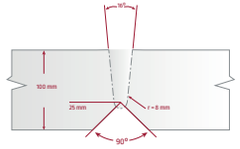
USER'S ADVANTAGES

Purchase less flux for completing your project
Reduce your waste generation

* **At 1m/min travel speed, 30 and 35V for standard and Long Stick Out respectively.**
For 100 kg of deposited weld metal, the quantity of additional recyclable flux is 16 kg.

SAVINGS CALCULATION

Application:



Joint Parameters:
Base material: S355 G10+M
Thickness: 100 mm
Included Angle: 16°
Length per year: 40 000 m

Process: SAW			**DC+/AC Tandem Standard SO**	**DC+/AC Tandem 1 Long SO**	**AC/AC Tandem 2 Long SO**	**AC/AC/AC Triple Arc 3 Long SO**
Consumable: FLUX + SOLID WIRE			**Oerlikon/Lincoln EH 12 K**			
Process parameter	Stick Out	(mm)	35	35-150	150	150
	Wire Diameter	(mm)	4	4	4	4
	Current	(A)	700	700	700	700
	Av. Heat Input	(kJ/mm)	3,6	3,4	3,4	3,4
	Av. Deposition Rate	(kg/h)	**20,00**	**28,00**	**37,00**	**43,00**
Consumables cost	Wire	(€/kg)	2,80	2,80	2,80	2,80
	Flux	(€/kg)	2,30	2,30	2,30	2,30
	Ratio Flux/Wire		**0,73**	**0,67**	**0,53**	**0,53**
	Total cost/kg weld	(€/kg)	4,48	4,34	4,02	4,02
Production cost	Labour cost	(€/h)	50	50	50	50
	Duty cycle	(%)	60	60	60	60
	Weight per meter weld	(kg/m)	23,50	23,50	23,50	23,50
	Time per meter weld	(h/m)	1,96	1,40	1,06	0,91
	Cost per meter weld	(€/m)	**203**	**172**	**147**	**140**
Total	Total length	(m)	40 000			
	Total weight	(kg)	940 000			
	Total welding time	(h)	78 333	55 952	42 342	36 434
	Total cost	(€)	**8 126 927**	**6 878 159**	**5 894 977**	**5 599 565**
Time savings vs Tandem standard stick out				-22 381 h	-35 991 h	-41 899 h
Cost savings vs Tandem standard stick out				-1 248 768€	2 231 950 €	-2 527 361 €

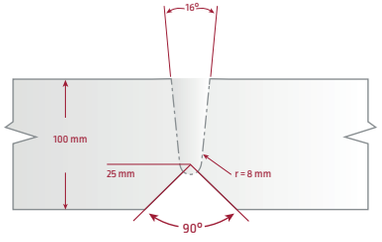
Tandem 2 LSO vs Tandem 2 standard SO means **saving a 25 kg flux bag every 6 m**

-29% -46% -53%

-15% -27% -31%

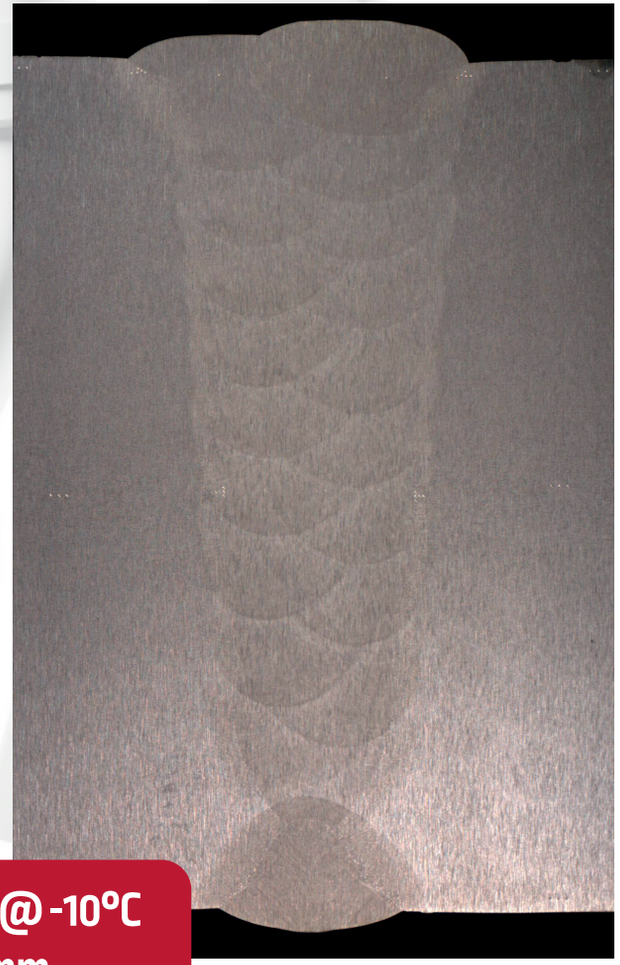
DCR DOCUMENTED COST REDUCTION

Application:



TESTED IN OFFSHORE WIND JOINTS

S355G10+N	
Thickness	**100 mm**
Flux	OP128TT
Wire	OE-SD3
Application	**Tandem LSO**
Tensile Transverse Rm	509/514MPa
AWM Tensile Rp0.2	480/517MPa
Bend test	OK
Test Temperature	-60°C
Weld metal Cap	86J
Weld metal (1/2t)	170J
BM	168HV10
HAZ	229HV10
Weld	228HV10



& CTOD (δ) -@ -10°C
>1.74 mm
>1.73 mm
>1.78 mm

EXCEEDING INDUSTRY AND END USER REQUIREMENTS

THE LONG STICK OUT PROCESS

In submerged arc welding, Stick Out, is the distance between the contact tip and the work piece. This distance can be increased using dedicated extensions of various lengths to obtain what is known as Long Stick Out (LSO). The wire electrical resistance increases with its length. Thanks to the "Joules" effect, the electrode is pre-heated and melts faster than it would, at the same amperage, with standard Stick Out.

Double your deposition rate

+9 kg/hr deposition rate

SINGLE ARC STD. DC+

8 kg/h

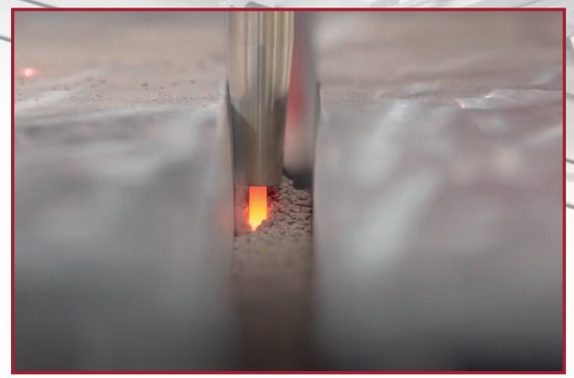
STANDARD STICK OUT

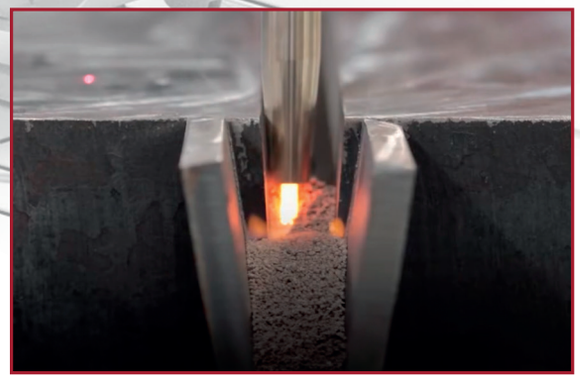
SINGLE ARC LSO

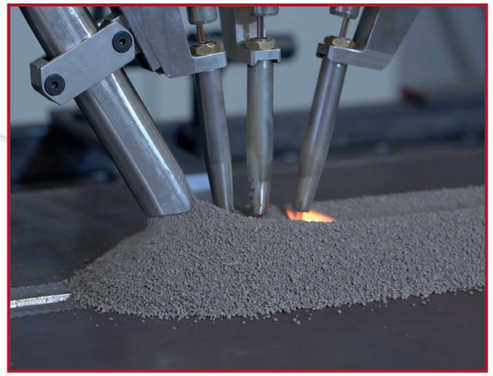
17 kg/h

LONG STICK OUT

WATCH VIDEO







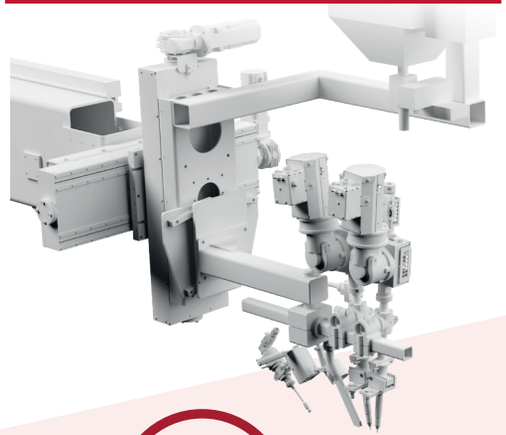
REDUCED ARC TIME
HIGHER PRODUCTIVITY AND EFFICIENCY

- The long stick out process is the most productive of the single power source processes.
- In Tandem, 1 or 2 LSO torches can be used. In the 2 LSO configuration, deposition rates can easily exceed 37 kg/h using 4 mm wires.
- Triple Arc LSO is the most efficient configuration for modern offshore wind application, with deposition rates higher than 43 kg/h.

USER'S ADVANTAGES

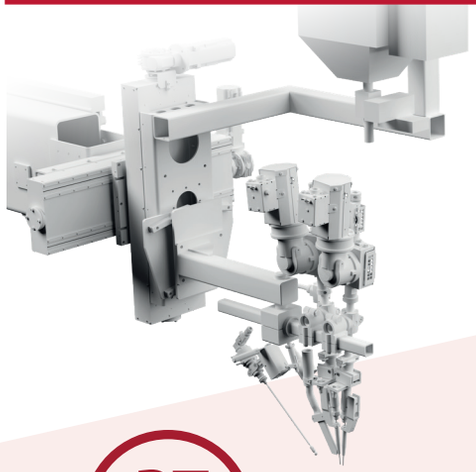
- Easy torch installation
- Reduced number of passes
- Reduced flux consumption
- Preserved mechanical properties

SAW TANDEM ARC STD.



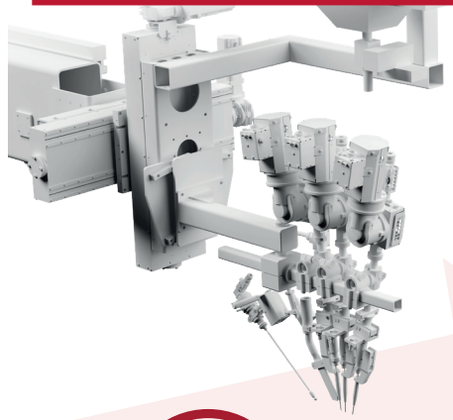
20 kg/h

SAW TANDEM LSO

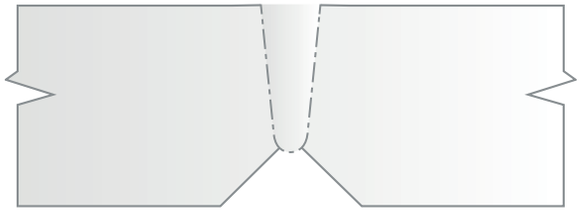


37 kg/h

SAW TRIPLE ARC LSO



43 kg/h



KEY COMPONENTS

REQUIRED equipments:

- **Power Wave® AC/DC1000® SD:** State of the art power source which insures consistent arc starts.
- **Maxsa 10&22 controller and head :** Robust and easy to use operator interface.
- **Positive contact torch (K148):** Easy to mount and engineered for LSO.

KNOW MORE

Power Wave® AC/DC 1000® SD

WELDING POLARITY CHARACTERISTICS

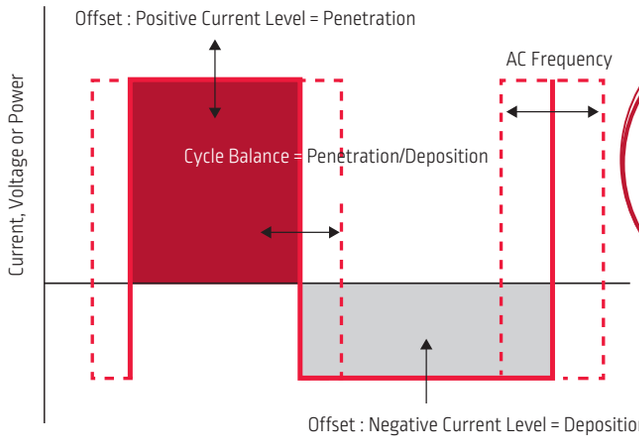
DC +
- Most common mode
- Deep penetration and stable arc

DC-
- Improves deposition rate
- Limits penetration
- Limited arc stability

AC
- A compromise between the two DC modes
- The optimum choice

Waveform Control Technology® : customised AC mode

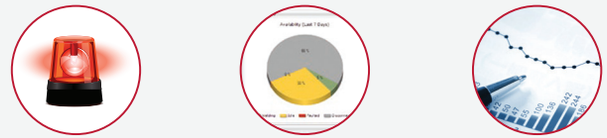
- **Frequency**
  Number of switches per second from positive to negative polarity
- **Balance**
  Percentage of time in the positive polarity part of a cycle
- **Offset**
  Positive/Negative Amplitude



OPTIMISED PENETRATION & DEPOSITION RATE

USER'S ADVANTAGES

- Wave form control
- Low electrical consumption
- Easy set up and control of multiples arcs
- Check Point (welds recording and monitoring)



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.

FOR MORE INFORMATION SCAN HERE

www.lincolnelectric.eu

DEDICATED CONSUMABLES

Lincoln Electric offers a wide portfolio of welding consumables fulfilling the highest standard requirements. The most frequently used in the wind industry are reported below. Depending on required mechanical properties and joint configuration more options are available.*

	Two and Multi-run welds	QR code	Multi-run welds with CVN down to -60°C	QR code
FLUX	• OP 128TT		• OP 121TT	
WIRE OPTIONS	• OE-SD2		• OE-SD3	
	• OE-SD3		• OE-SD3 1Ni 1/4Mo	
	• OE-S2Mo			

Want to learn more?
Please contact us to book an appointment.

*Please contact your local representative for advice on other consumables alternatives.

ARC
APPLICATION RESOURCE CENTER

APPLICATION RESOURCE CENTER

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 enquiries 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.

Lincoln Electric is a responsive manufacturer, but the selection and use of specific products sold by Lincoln Electric is solely within the control of, and remains the sole responsibility of the customer. Many variables beyond the control of Lincoln Electric affect the results obtained in applying these types of fabrication methods and service requirements.

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