

Submerged Arc Welding



SAW Process

The mechanics of Submerged Arc Welding process (SAW)

Both the electrode and the base metal are melted beneath a flux layer. This layer protects the weld metal from contamination and concentrates the heat into the joint. The molten flux rises through the pool, deoxidising and cleaning the molten metal. It then forms a protective slag covering and maintaining the newly deposited metal.

Arc characteristic

CV and CC mode

Due to the wide range of wire diameter that can be used in SAW, this process can be performed either on CV or CC mode:

Constant Voltage mode (CV): This mode fits perfectly with small diameter electrodes. It offers great arc stability and reactivity as it holds the wire feed speed () constant and varies the current in order to drive the voltage to setpoint. This mode guaranties a constant deposition rate.

Constant Current mode (CC): This mode is usually applied with large diameter electrode. It varies the wire feed speed in order to drive the voltage and current (Amps) to setpoint. This mode guaranties a constant penetration.

Electrode polarity

SAW can be performed either in:

- ✓ DC+ to obtain the maximal penetration
- ✓ DC- to obtain the maximal deposition rate
- ✓ AC to get an intermediate solution between DC+ and DC-
- ✓ AC to limit arc blow effect

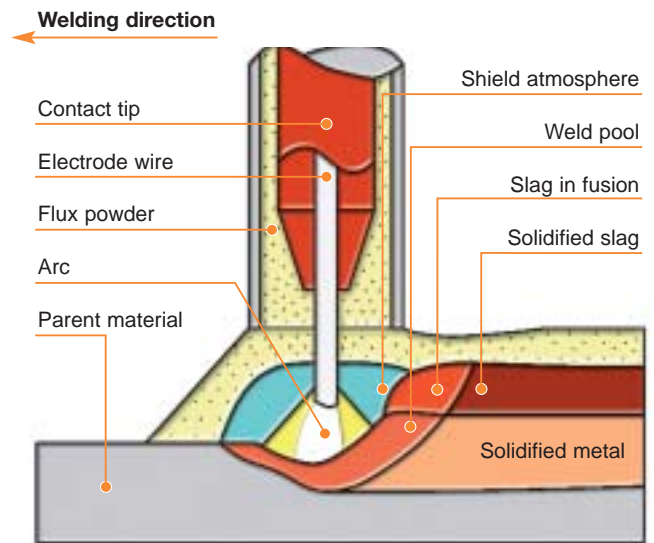
Advanced features

Strike time: Arc ignition can be improved by adjusting the wire feed speed at striking.

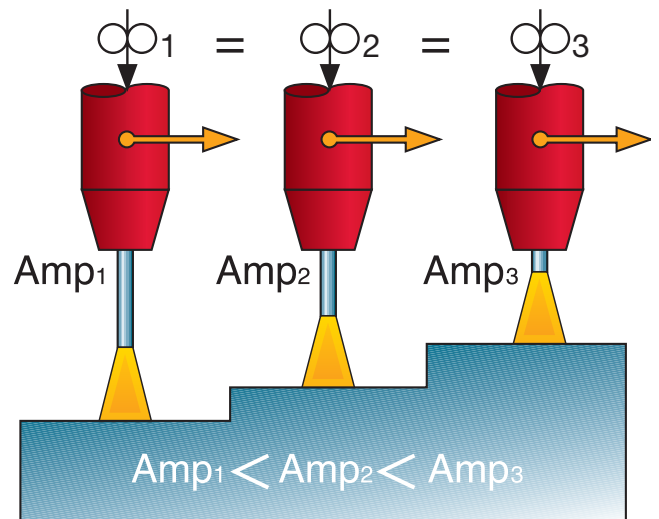
Arc start control / Crater control: Start and stop of the weld are always 2 transition periods. Welding parameters can be adjusted differently, during these welding sequences, to control penetration and filling.

Burnback time: This function prevents the wire to be stuck to the joint at the end of the weld.

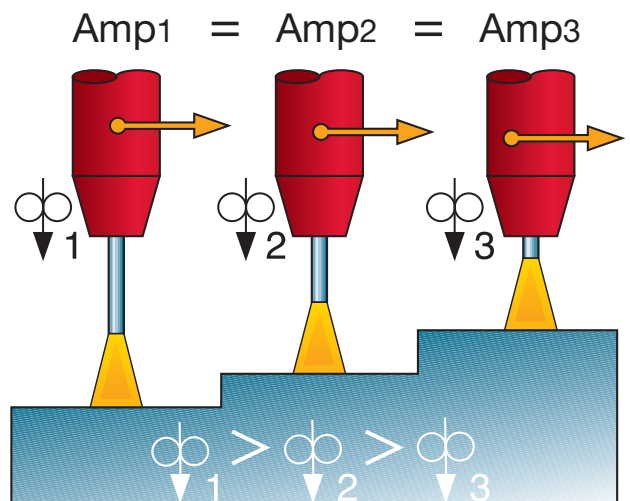
Subarc Process



CV Mode



CC Mode



Applications

Segment and applications

- Light & heavy industry with non alloyed products
- Pressure vessels with low alloyed products
- Pipemills all grades
- Offshore with low alloyed products
- Process industry with low & high alloyed products

Materials

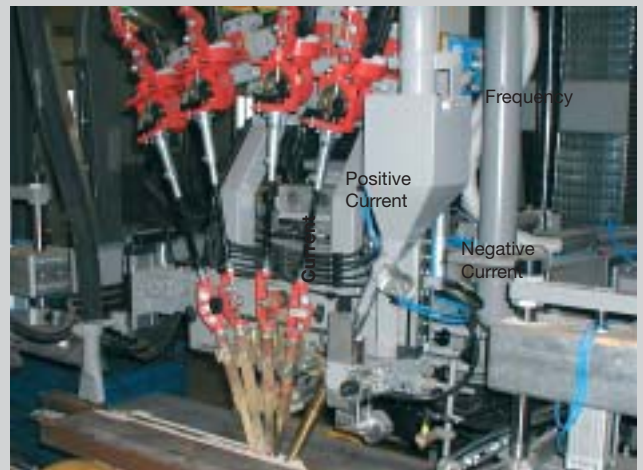
- Carbon steel
- Stainless steel
- Nickel based alloys

Equipment requirements

- Robustness
- Outstanding welding performance
- High duty cycle
- Versatility of welding mode
- Modularity

SAW diversity

Process	equipment	advantages
Single arc	1 power source 1 feeding head 1 wire	• Cheapest configuration
Twin arcs	1 power source 1 feeding head 2 wires	• High travel speed • Increased deposition rate • Low cost investment
Tandem arcs	2 power sources 2 feeding heads 2 wires	• Productivity improvement • Flexibility of welding configuration
Long Stick-out	Linc-fill torch	• Deposition rate improvement at low cost investment



The Lincoln Solution

Idealarc® DC-655 - DC-1000 - AC-1200 - DC-1500



DC-655



DC-1000



AC-1200



DC-1500

Equipment

- Excellent arc characteristics with:
 - ✓ CV and CC modes for DC-655, DC-1000 and DC-1500
 - ✓ DC+/DC- switch button for DC-655, DC-1000 and DC-1500
 - ✓ 3 output studs with overlapping ranges for AC-1200
 - ✓ Possibility to use DC-655 and DC-1000 with GMAW, SMAW and FCAW processes
- 3 phase input for DC-655, DC-1000, DC-1500
- 1 phase input for AC-1200
- Rugged design for impact resistance and toughness
- IP 23 classified
- 3-year warranty on parts and labour

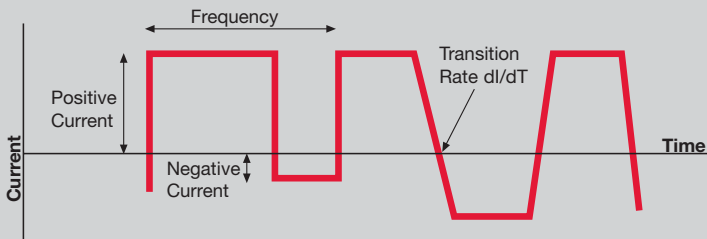
The new Sub Arc Power Source Generation

Power Wave® AC/DC 1000® SD

The Power Wave® AC/DC 1000® SD is the first submerged arc power source equipped with the Waveform Technology®.

When working with alternative current polarity, wave form current can be tuned. By modifying Balance, Offset, Arc Frequency and Phase angle (in multi arcs applications), it is now possible:

- ✓ To increase deposition rate at a constant heat input
- ✓ To increase penetration at a constant heat input
- ✓ To adjust the bead shape easily
- ✓ To reduce arcs interactions
- ✓ To synchronize up to 4 arcs in the same puddle with standard equipment

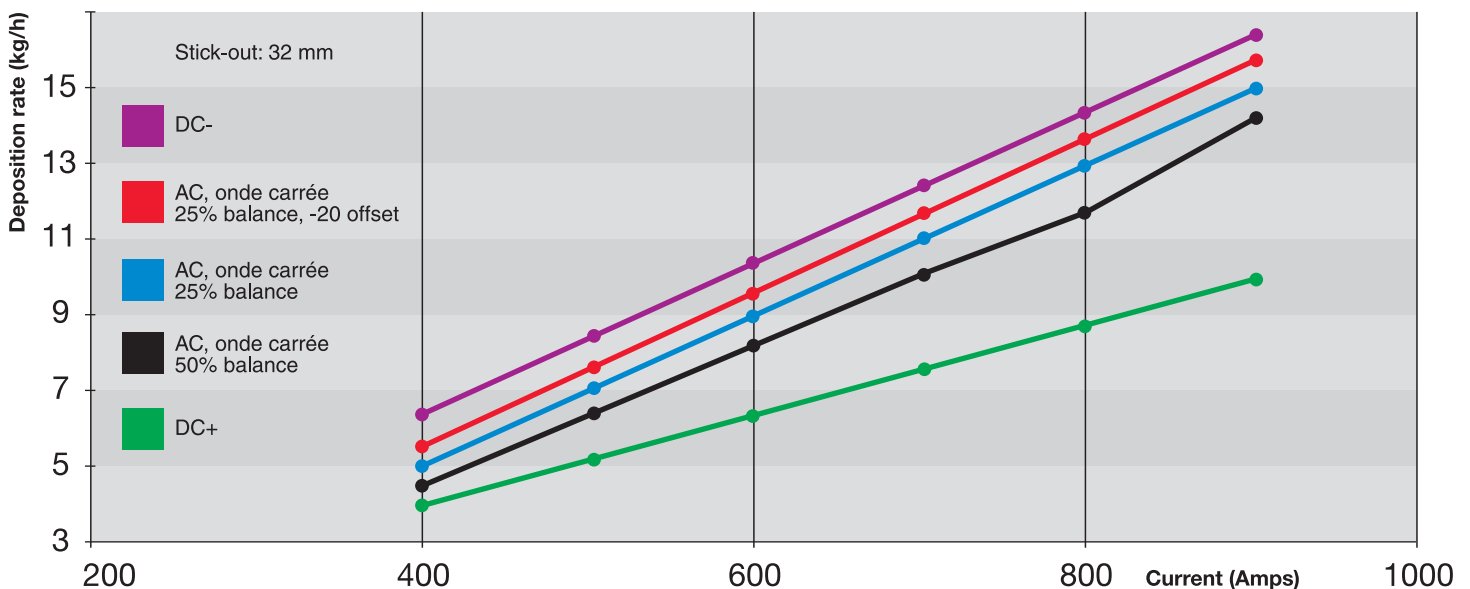


The Power Wave® AC/DC 1000® SD innovates also with:

- ✓ Its great modularity:
 - DC and AC (sine wave and square wave) modes available with the same machine without any layout modification
 - Easy to parallel
- ✓ Its square wave alternative current to improve arc consistency
- ✓ The AC coming from a 3 phase input technology
- ✓ An AC process combined with CV mode to get the best stability for small wire diameter
- ✓ A built-in data acquisition system for QA and QC purposes and procedure development
- ✓ 6 memories for welding procedure
- ✓ Metric or English units display
- ✓ Its remote control
- ✓ An Ethernet communication system to connect the machine to the company Ethernet network
- ✓ Electrical costs reduction thanks to its 87% efficiency and 95% power factor

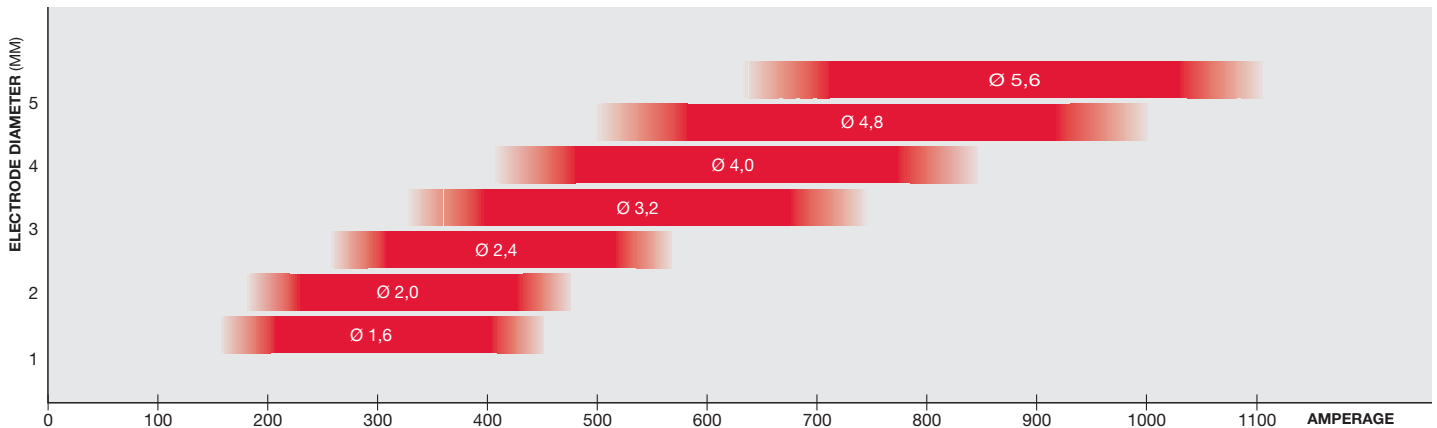


Melting curves of a 4 mm diameter wire with a Power Wave® AC/DC 1000® SD



Product Application Chart

Wire diameter selection



Control Panels



NA-3



NA-4



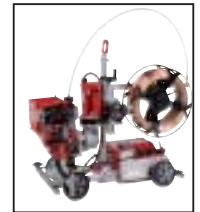
NA-5



MAXsa™ 10



LT-7



CRUISER™

The LT-7 tractor is to be used with conventional machines whereas the Cruiser™ tractor is designed to be used with the Power Wave® AC/DC 1000® SD.

Power sources technical specifications

Power sources	Input power (V/ph/Hz)	Rated output current/voltage/ duty cycle	Output	Output range	Weight (kg)	Dimensions HxWxD (mm)
Idealarc® DC-655	230/400/3/50-60	650A/44V/100% 850A/44V/60%	CV DC	50A-815A	327	699x564x965
Idealarc® DC-1000	230/380/440/3/50-60	1000A/44V/100% 1250A/44V/50%	CC/CV DC	150A-1300A	372	781x572x991
Idealarc® DC-1500	380/440/3/50-60 or 415/3/50-60	1500A/60V/100%	CC/CV DC	200A-1500A	644	1453x566x965
Idealarc® AC-1200	380/1/50-60 or 415/1/50-60	1200A/44V/100%	CC AC	200A-1500A	712	1453x560x970
Power Wave® AC/DC 1000® SD	380/400/460/500/575 3/50-60	1000A/44V/100%	CC/CV AC/DC	200A-1000A	295	1105x488x838

Control box specifications

Control box	Input power	Wire feed speed range (m/min)	Wire size range (mm)	Welding mode	Pre-setting	Analog/ Digital	Memories	Arc start, crater time and burnback
NA-3	115 VAC	0,6-16,5	1,6-5,6	CC/CV DC	No	Analog	No	Option
NA-4	115 VAC	subject to arc voltage used	1,6-5,6	CC/CV AC	No	Analog	No	Option
NA-5	115 VAC	0,6-16,5	0,9-5,6	CV DC	Yes	Digital	No	Yes
MAXsa™10 controller	40 VDC	low: 0,25-5 High:0,6-8	2,0-5,6	CC/CV AC/DC	Yes	Digital	Yes	Yes
LT-7 tractor	115 VAC	0,25-10,2	2,4-4,8	CC/CV DC	No	Analog	No	Option
Cruiser™ tractor	40 VDC	0,4-5,0	1,6-5,6	CC/CV AC/DC	Yes	Digital	Yes	Yes

Consumable data

Joint design	Base material	welding conditions and/or requirements	Flux and wire combinations
Fillet welds	Mild steels	Rusty plates	761 with L61, L50M
		Oily plates	761 and 780 with L60
		High speed	780 with L61, L50M and LNS140A
		High speed on thin and clean plates	781/782 with L60, L61, L50M and LNS140A
		Heavy throat, Steel beam manufacturing	960 with L60, L61 L50M and LNS140A
	Stainless steels		P2007 or P2000S with LNS 304L, LNS309L, LNS316L, LNS318L
Two-run welds	Mild steels	Impact at 0°C	761/780/781/782 with L60, L61 and L50M
		Impact at -20°C	780,781,782 with, L61, L50M & LNS140A
			P230 with L61; 860 with L61, L50M and LNS140A
		Impact at -40°C Impact at -60°C	P230/LNS140A; P230/L50M 995N/LNS140TB
	Stainless steels		P2007 or P2000S with LNS 304L, LNS309L, LNS316L, LNS318L
Multirun welds	Mild steels	Impact at -20°C; Re≤440MPa	960 with L61 and L50M
		Impact at -20°C; Re≤520MPa	860 with L61, L50M, LNS140A
		Impact at -40°/-60°C; Re<500MPa	888 with L61, P230, L50M, LNS160
		Impact at -60°C after post weld heat treatment (PWHT)	888/P230/P240 with LNS160, LNS162
	Low alloy steels	Impact at -50°/-60°C; 500MPa without PWHT	888 with LNS162/P230/P240
		Impact at -50°/-60°C; Re≥500MPa after PWHT	888/LNS165, 8500/LNST55
			Impact at -30°/-40°C; Re≥600MPa High temperature application / step cooling
	Ni Base		P2007 with LNS NiCro 60/20, LNS NiCroMo 60/16 P7000 with LNS NiCro 60/20, LNS NiCroMo 60/16
	Stainless steels		P7000 with LNS 4455 P2007 or P2000S with LNS 304L, LNS309L, LNS316L, LNS318L
One side welding	Naval grades	Impact at 0°C, same flux for welding and backing	761/L61
		Impact at -20°C, same flux for welding and backing	761/LNS140A (single run); 995N/LNS140TB

All mentioned consumables, joint design and base material type are meant as an example. Lincoln Electric has a much wider range of consumables. Should you have any questions regarding the availability of SAW consumables, please ask your Lincoln Electric representative.

Most common nozzles



K129

Tiny twinarc



K148

Nozzle (heavy duty)



K231

Nozzle

Your Lincoln Electric Distributor:

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www.lincolnelectric.eu

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