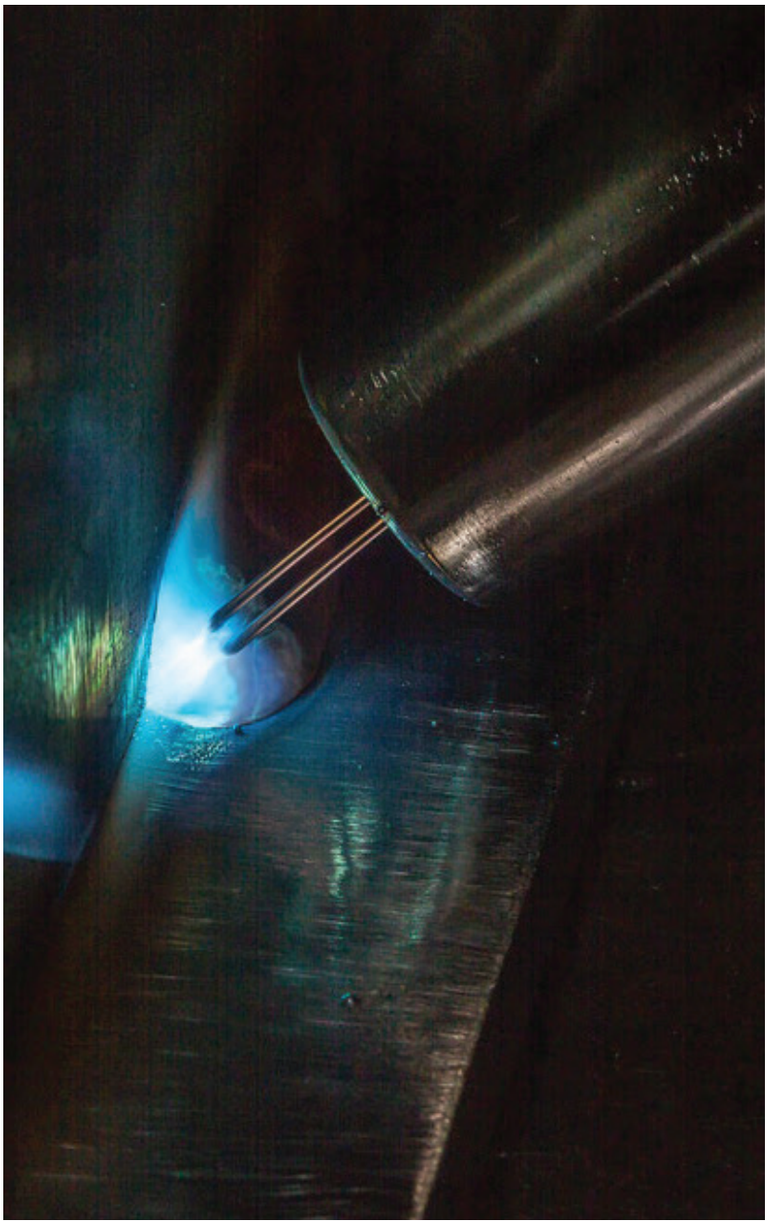
PROCESS GUIDE

HyperFill™



Overview

HyperFill™ – Higher Deposition. Lower Difficulty.

- Increase deposition rates
- Easily control large weld puddles
- Robust penetration profiles

Index

PublicationTE12.026 | Issue Date 03/19

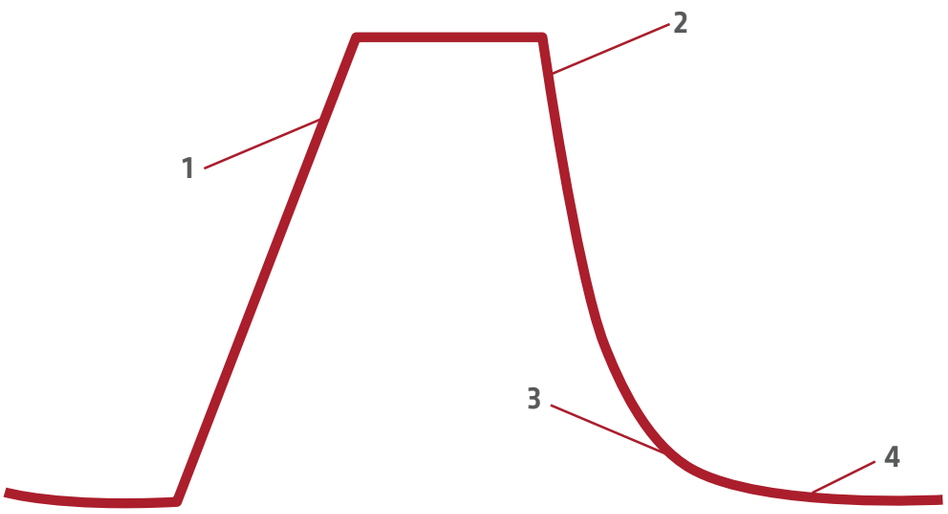
www.lincolnelectric.com

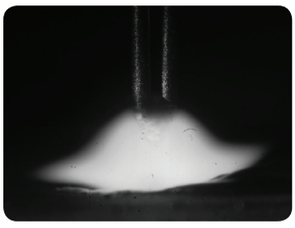
LINCOLN ELECTRIC

Process Description

HyperFill™ is a patent pending twin-wire GMAW-P solution that utilizes two electrically conductive wires, energized by a single power source and fed through a single wire feeder, single gun liner and a single tip. By substituting a large diameter wire for two smaller diameter wires, the HyperFill process increases the droplet size and spreads out the arc cone, allowing for improved deposition rates while maintaining arc stability. The result is a process that increases the usable deposition rates of GMAW while making it simpler for the operator to manage a large weld puddle.

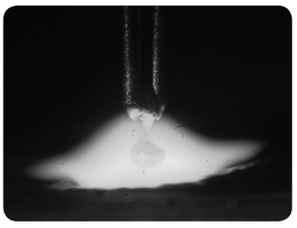
Waveform





1. Ramp

As current increases from background to peak, the ends of the wire become hot, start to become liquid, and the magnetic fields around the wires, push the liquid into a common droplet, forming a "liquid bridge".

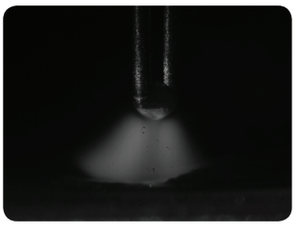


2. Peak

The high and long peak current apply pinch force to the liquid bridge droplet pushing it toward the weld pool and separating it from the consumable wires.

3. Tailout

The slow tailout completes separation of the droplet from the wire, propelling the droplet toward the weld pool.



4. Background

The background maintains the arc, supplies heat to the weld pool, and allows the wire feeder to advance wire making it ready to transfer the next droplet.

Synergic Welding

1. Adjust WFS to the desired setting. Refer to the Applications section for the recommended settings.

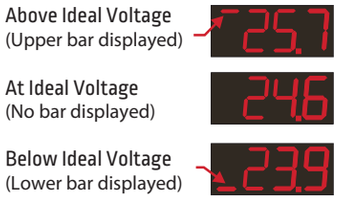
Voltage and UltimArc®

2. Based on WFS, a pre-programmed nominal voltage is selected.

3. Adjusting voltage increases or decreases the arc length, allowing the user to fine tune arc characteristics.

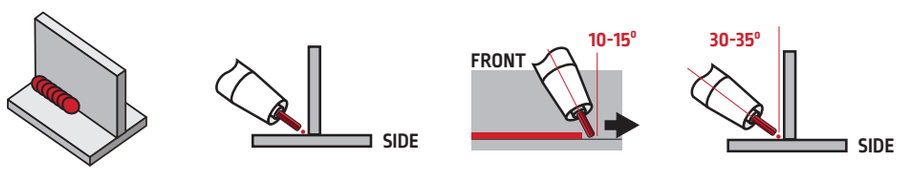
4. Synergic Weld modes improve the ease of set-up by pre-selecting an ideal voltage based on the selected WFS. The user can then fine tune their Voltage setting based on their personal preference and can easily see whether they are above or below the nominal setting.

Voltage Display



Fillet Weld Procedures - 8 mm (5/16 in)

PLAIN CARBON STEEL	
Travel Angle	10-15° Push
Work Angle	30-35°
CTWD	
0.875 - 1 in	22 - 25 mm



Position the wire approximately one wire diameter outside the joint

ENGLISH

HyperFill™ 0.035 in		lbs/hr	in/min	in/min	V	A
	3/8 in and up	16	515	16	28.4	343
		18	580	18	29.9	374
		20	645	20	30.9	418
		22	710	22	32.7	460

METRIC

HyperFill™ 0.9 mm		kg/hr	m/min	cm/min	V	A
	10mm and up	7.25	13.1	40.6	28.4	343
		8.1	14.7	45.7	29.9	374
		9.07	16.4	50.8	30.9	418
		9.97	18.1	55.9	32.7	460

ENGLISH

HyperFill™ 0.040 in		lbs/hr	in/min	in/min	V	A
	3/8 in and up	16	375	16	27.1	358
		18	425	18	28.4	391
		20	468	20	29.7	431
		22	515	22	31.7	472
		24	562	24	32	516

METRIC

HyperFill™ 1.0 mm		kg/hr	m/min	cm/min	V	A
	10mm and up	7.25	9.5	40.6	27.1	358
		8.1	10.8	45.7	28.4	391
		9.07	11.9	50.8	29.7	431
		9.97	13.1	55.9	31.7	472
		10.9	14.3	60.1	32	516

Material Thickness | Deposition Rate | Wire Feed Speed | Travel Speed | V Volts | A Amps

Fillet Weld Procedures - 8 mm (5/16 in)

ENGLISH

HyperFill™ 0.045 in		lbs/hr	in/min	in/min	V	A
	3/8 in and up	16	296	16	27.5	395
		18	333	18	28.5	436
		20	370	20	29.3	472
		22	407	22	30	507
		24	444	24	31.5	535

METRIC

HyperFill™ 1.1 mm		kg/hr	m/min	cm/min	V	A
	10mm and up	7.25	7.5	40.6	27.5	395
		8.1	8.5	45.7	28.5	436
		9.07	9.4	50.8	29.3	472
		9.97	10.3	55.9	30	507
		10.9	11.3	60.1	31.5	535

Material Thickness · Deposition Rate · Wire Feed Speed · Travel Speed · V Volts · A Amps

Operator Usability Graph

ENGLISH

Wire Feed Speed - in/min

	Deposition Rate - lbs/hr					
Wire Diameter - in	**14**	**16**	**18**	**20**	**22**	**24**
1/16	273	311	350	390	429	468
0.045	518	592	666	740	800	
0.052	388	443	498	554	609	
0.052 (MC)	435	498	560	622	669	
1/16 (MC)	307	350	394	438	481	525
0.035 - Twin	451	515	580	645	710	
0.040 - Twin	327	375	425	468	515	562
0.045 - Twin	259	296	333	370	407	444

METRIC

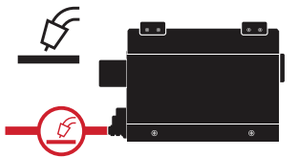
Wire Feed Speed - m/min

	Deposition Rate - kg/hr					
Wire Diameter - mm	**6.35**	**7.25**	**8.1**	**9.07**	**9.97**	**10.9**
1.6	6.9	7.8	8.9	9.9	10.9	11.9
1.2	13.2	15.0	16.9	18.8	20.3	
1.4	9.9	11.3	12.6	14.1	15.4	
1.4 (MC)	11.0	12.6	14.2	15.8	17.0	
1.6 (MC)	7.8	8.9	10.0	11.1	12.2	13.3
0.9 - Twin	11.45	13.08	14.7	16.4	18.03	
1.0 - Twin	8.3	9.5	10.8	11.9	13.1	14.3
1.2 - Twin	6.6	7.5	8.5	9.4	10.3	11.3

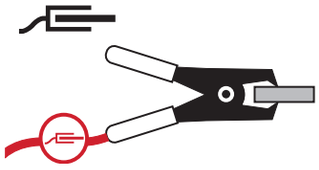
Good · Not Ideal · Bad

Sense Leads

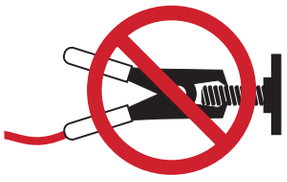
An electrode sense lead is required. This is a standard connection in an ArcLink® cable.



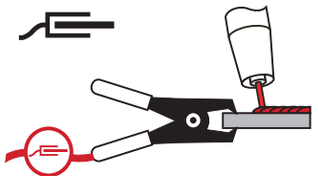
A work sense lead (optional) is highly recommended for total welding cable lengths >50 ft. and should be connected directly to the workpiece.



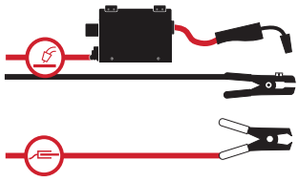
DO NOT connect either sense lead to a welding stud on the power source as this may result in erratic arc behavior.



For best performance, connect the work sense lead close to the welding arc.



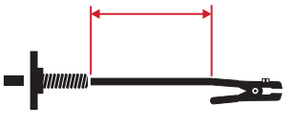
The work sense lead should be separated away from welding cables to minimize interference.



DO NOT route sense lead cable close to high current welding cables as this may distort the sense lead signal.

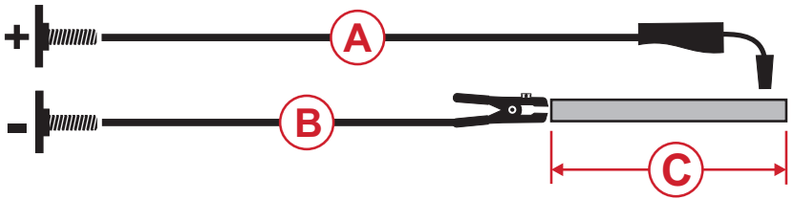
Work Leads

Connect the work lead to the negative stud on the power source and directly to the workpiece. Maintain the shortest connection length possible.

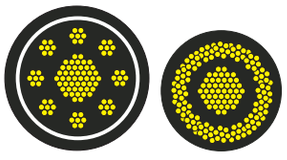


Test cable inductance levels using the Power Wave® Manager software exclusively from Lincoln Electric® Software. Available at www.powerwavesoftware.com.

The total length of the welding current loop (A+B+C) should be minimized to reduce inductance. Route cables (A,B) close together to further reduce cable inductance.

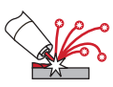
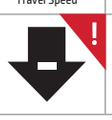


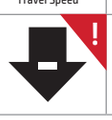
For configurations with excessive inductance, use Lincoln Electric® patented coaxial welding cables.

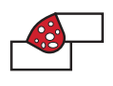


Lincoln Electric® coaxial cables combine the positive and negative welding leads into one cable to minimize cable inductance.

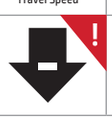
Troubleshooting

 SPATTER	Check ▶	Volts	Travel Speed	Contact Tip to Work Surface	Wire Feed Speed	Gas Coverage	Push Angle	Work Sense Lead
	Action ▶							

 ERRATIC ARC	Check ▶	Travel Speed	Proper Feeding	Volts	Wire Feed Speed	Push Angle	Tip	Surface Contaminates	Work Sense Lead
	Action ▶								

 POROSITY	Check ▶	Gas Coverage	Surface Contaminates	Contact Tip to Work Surface
	Action ▶			

 CONCAVE BEAD	Check ▶	Volts	Wire Feed Speed	Contact Tip to Work Surface	Push Angle
	Action ▶				

 CONVEX BEAD	Check ▶	Travel Speed	Wire Feed Speed	Volts	Contact Tip to Work Surface	Push Angle
	Action ▶					

 Increase

 Decrease

 Inspect & Replace

 Important

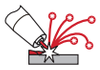
Troubleshooting

BURN THROUGH	Check ▶	Travel Speed	Wire Feed Speed	Volts	Contact Tip to Work Surface	Push Angle
	Action ▶	!	!			

POOR PENETRATION	Check ▶	Travel Speed	Wire Feed Speed	Contact Tip to Work Surface	Push Angle
	Action ▶	!	!		

Increase | Decrease | Inspect & Replace | Important

Icons

 Wire Type	 Gas	 Material Thickness	 Wire Feed Speed	 Travel Speed	 Volts	 Amps	 Contact Tip to Work Surface	 Drag Angle	 Arc Length
 Control Knob	 Weld Stud	 Torch	 Work Sense Lead	 Work Clamp	 Torch Nozzle	 Spatter	 Erratic Arc	 Proper Feeding	 Stop / Avoid
 Knurled Drive Rolls	 Gas Coverage	 Porosity	 Concave Bead	 Burn Through	 Under Cut	 Convex Bead	 Poor Penetration		

Technical Terms

Cable Inductance	Resistance to change in current.
GMAW	Gas metal arc welding including metal inert gas (MIG) and metal active gas (MAG) welding.
Porosity	Gas entrapped in solidifying metal forms spherical or elongated pores in the weld.
Push Angle	The angle at which the electrode leads the weld pool relative to the direction of travel.
Synergic	A mode of control which automatically selects a pre-programmed nominal voltage based on the wire feed speed (WFS) set by the operator.
Work Angle	The angle of the electrode, off perpendicular, relative to the work piece surface.

Procedure Notes

All listed procedures are starting points and may require some adjustment depending on the specific application.

Torch angle, electrode placement, contamination, mill scale, joint fit up, and joint consistency are factors that may require special consideration depending on the specific application.

At higher travel speeds, joint fit up, wire placement, and contamination all become factors that are more significant.

The result of welding at higher travel speeds is a tendency to produce more spatter, less penetration, more undercut, and a less desirable bead shape. Depending on the limitations / requirements of the actual application, slower travel speeds and higher arc voltages may be required.

As the travel speed increases in fast follow applications (1/4" to 14 Gauge), a tighter arc length must be maintained so that the puddle properly follows the arc. Operators typically reduce the arc length control (Voltage) to achieve this. At faster travel speeds, the bead-shape can become very convex (or ropy), and the weld will not "wet" well. There is a point at which the arc is set so short that the arc will become unstable and stubbing will occur. This forms a limitation of just how fast the travel speed can be raised.

It is ultimately the responsibility of the end user to ensure the proper weld deposition rate, bead profile, and structural integrity of a given weld application.

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.

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.

Subject to Change – This information is accurate to the best of our knowledge at the time of printing. Please refer to www.lincolnelectric.com for any updated information.