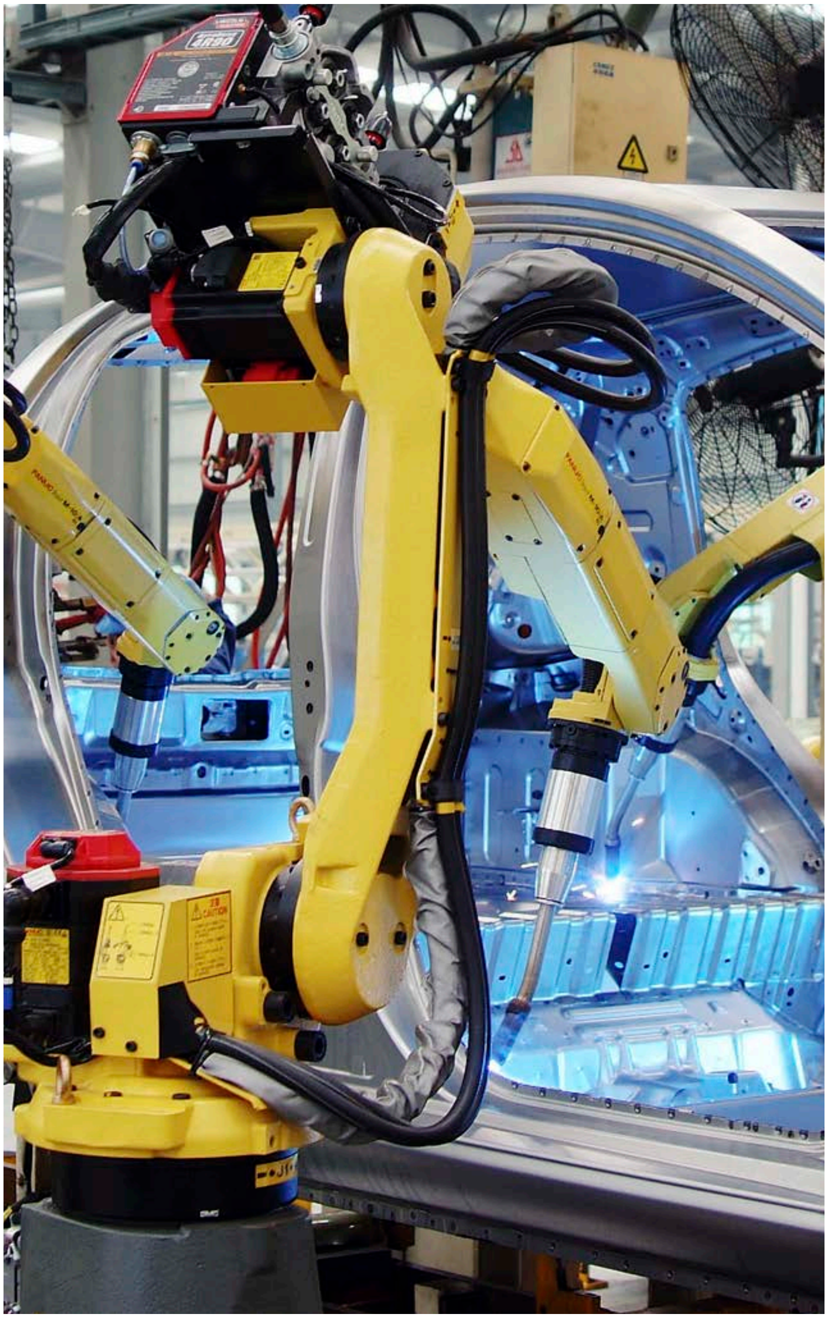
AC-STT™ Weld Process



Overview

AC-STT™ - The Superior Thin-Gauge Solution

- Low spatter
- Controlled Heat Input
- Decreases Burnthrough
- Reduces Distortion

Index

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Process Description

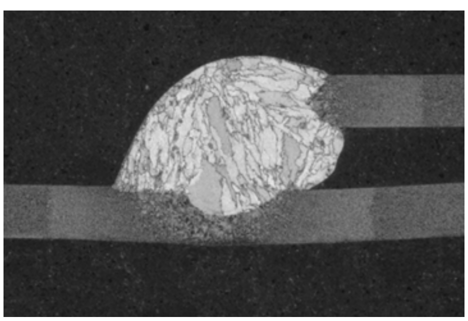
Based off of the patented STT® (Surface Tension Transfer) process, AC-STT™ combines the proven spatter-reducing technology of the STT® waveform with the reduced heat-input characteristics of AC GMAW. AC-STT™ provides a complete solution for welding thin sheet metal 18 Ga to 24 Ga while accommodating for poor fit up with the resulting gap.

THIN GAUGE LAP WELDING WITH STT

	Zero Gap	0.25 mm Gap	0.5 mm Gap
18 Ga (1.3 mm)	DC+	DC+	DC+
20 Ga (1.0 mm)	DC+	DC+	DC+
22 Ga (0.8 mm)	DC+	DC+	DC+
24 Ga (0.8 mm)	DC+	DC+	

	Zero Gap	0.25 mm Gap	0.5 mm Gap
18 Ga (1.3 mm)	AC	AC	AC
20 Ga (1.0 mm)	AC	AC	AC
22 Ga (0.8 mm)	AC	AC	AC
24 Ga (0.8 mm)	AC	AC	AC

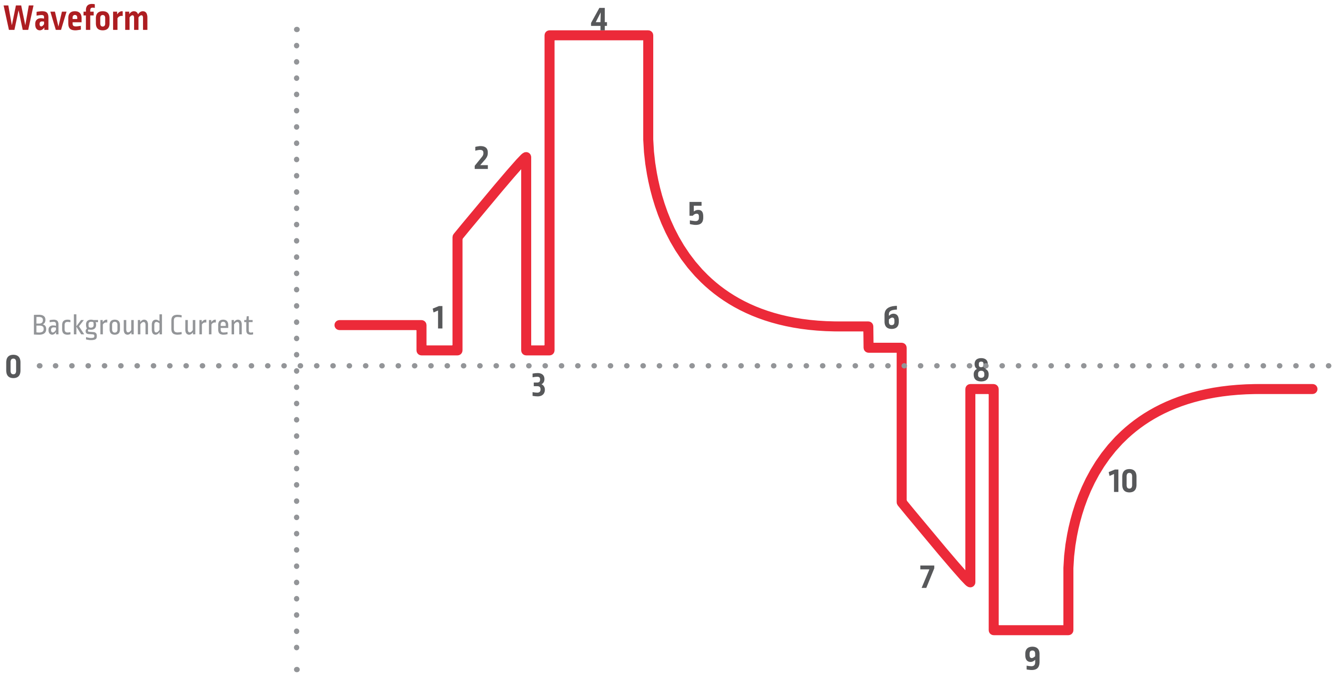
Possible Not Possible



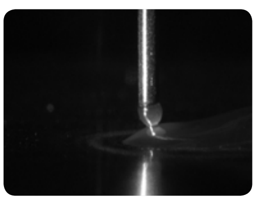
24 Ga to 24 Ga Lap Weld with 0.5 mm gap

AC-STT™ has the unique ability to reverse the polarity of the waveform to adjust Heat Input.The duration of welding in the positive and negative polarity is directly controlled by the operator using the Balance control. A Balance setting of 100% will result in a purely DCEP waveform with the highest heat input, while a setting of 0% will result in a purely DCEN waveform with the lowest heat input. A nominal setting of 50% creates a balanced waveform that alternates cycles of DCEP and DCEN STT. Other settings in between these values can be used to fine tune the heat input and penetration for each application.

Waveform

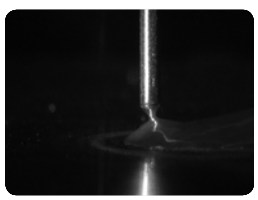


DC+



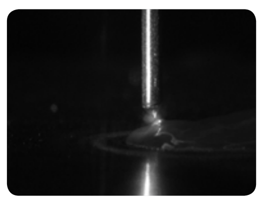
1. Wet-in

Molten ball makes initial contact with weld pool and current is instantly reduced.



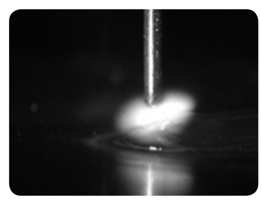
2. Pinch Current

As the wire necks down, special circuitry determines that the short is about to break.



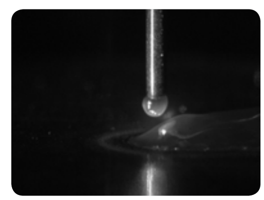
3. Detachment

The STT Switch quickly reduces the current at the instant the droplet detaches, reducing spatter



4. Peak Current

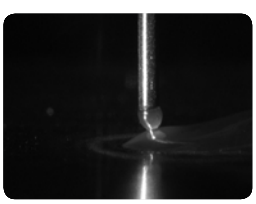
Peak Current sets a pre-defined arc length.



5. Tailout & Background

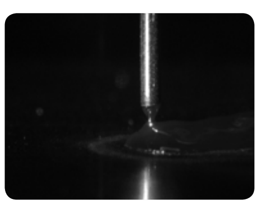
Background regulation maintains a consistent molten ball size.

DC-



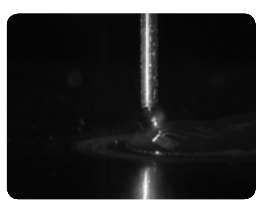
6. Wet-in

Molten ball makes initial contact with weld pool and current is instantly reduced.



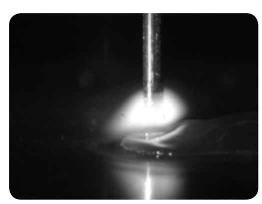
7. Pinch Current

As the wire necks down, special circuitry determines that the short is about to break.



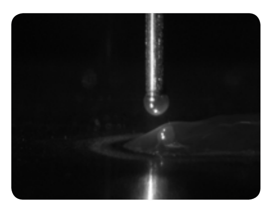
8. Detachment

The STT Switch quickly reduces the current at the instant the droplet detaches, reducing spatter



9. Peak Current

Peak Current sets a pre-defined arc length.



10. Tailout & Background

Background regulation maintains a consistent molten ball size.

Synergic Welding

1. Adjust WFS to the desired setting. Based on WFS a preprogrammed nominal voltage is selected. Refer to the Application section for the recommended settings.

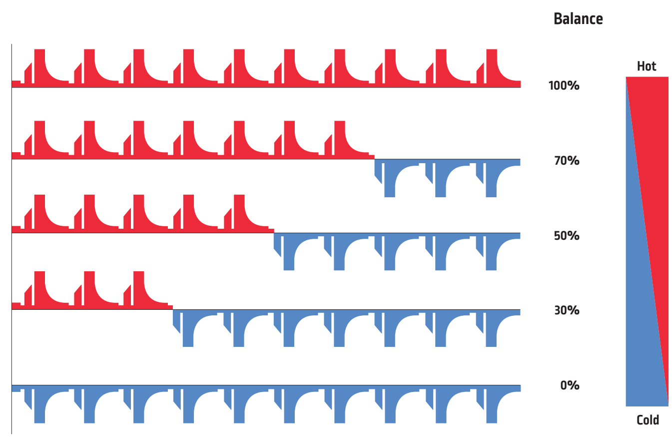
Trim, Balance and UltimArc®

2. Trim: Regulates voltage by adjusting Peak, Background and Tailout.

- When the arc voltage is increased, the shorting frequency lowers, the ball size increases, giving a softer arc with more energy.
- When the arc voltage is lowered, the shorting frequency increases, the ball size decreases, giving a more focused arc with less energy.

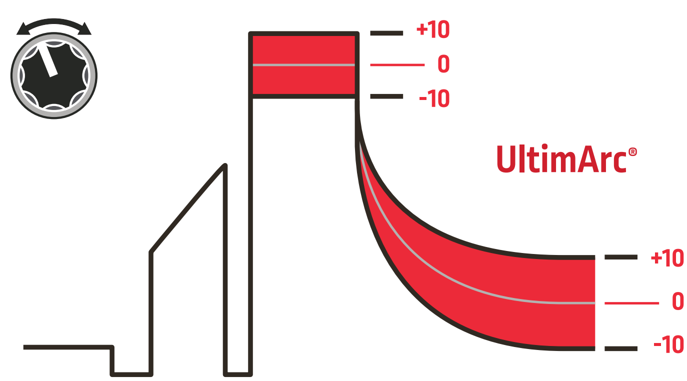
3. Balance: Determines ratio of DCEP and DCEN STT cycles.

- When the Balance is increased, the amount of DC+ cycles increases and DC- cycles decreases.
- When the Balance is decreased, the amount of DC- cycles increases and the DC+ cycles decreases.



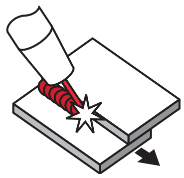
4. UltimArc®: Fine adjustment of the arc.

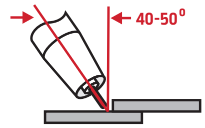
- In the positive direction it will produce a more focused arc by raising the peak, and lowering the background.
- In the negative direction, it will produce a more fluid and softer transfer by lowering the peak, and increasing background.



Lap Weld Procedures

NO GAP	
Travel Angle	10-20° Push
Work Angle	40-50°
CTWD	
0.625 in	15 mm





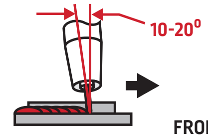
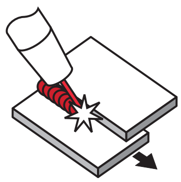
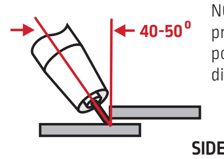


PLATE THICKNESS		WIRE	GAS	WFS in/min (m/min)	TRIM	BALANCE	ULTIMARC	TRAVEL SPEED in/min (cm/min)
18 Ga	1.3 mm	0.035 in, SuperArc® L-56	75% Ar / 25% CO_2	150 (3.8)	1	100	0	35 (89)
			100% CO_2	140 (3.5)	1	100	0	35 (89)
		1.0 mm, SupraMig® S-6	80% Ar / 20% CO_2	135 (3.4)	1	90	0	35 (89)
			100% CO_2	130 (3.3)	1	90	0	35 (89)
		0.045 in, SuperArc® L-56	75% Ar / 25% CO_2	120 (3.0)	1	80	0	35 (89)
			100% CO_2	120 (3.0)	1	70	0	35 (89)
		1.2 mm, SupraMig® S-6	80% Ar / 20% CO_2	110 (2.8)	1	60	0	35 (89)
			100% CO_2	110 (2.8)	1	60	0	35 (89)
20 Ga	1.0 mm	0.035 in, SuperArc® L-56	75% Ar / 25% CO_2	140 (3.5)	1	70	0	30 (76)
			100% CO_2	130 (3.3)	1	70	0	30 (76)
		1.0 mm, SupraMig® S-6	80% Ar / 20% CO_2	125 (3.1)	1	60	0	30 (76)
			100% CO_2	120 (3.0)	1	40	0	30 (76)
		0.045 in, SuperArc® L-56	75% Ar / 25% CO_2	120 (3.0)	1	50	0	30 (76)
			100% CO_2	110 (2.8)	1	40	0	30 (76)
		1.2 mm, SupraMig® S-6	80% Ar / 20% CO_2	105 (2.6)	1	30	0	30 (76)
			100% CO_2	100 (2.5)	1	30	0	30 (76)
22 Ga	0.8 mm	0.035 in, SuperArc® L-56	75% Ar / 25% CO_2	130 (3.3)	1	50	0	25 (63)
			100% CO_2	110 (2.8)	1	50	0	25 (63)
		1.0 mm, SupraMig® S-6	80% Ar / 20% CO_2	115 (2.9)	1	50	0	25 (63)
			100% CO_2	105 (2.6)	1	30	0	25 (63)
		0.045 in, SuperArc® L-56	75% Ar / 25% CO_2	105 (2.6)	1	25	0	25 (63)
			100% CO_2	100 (2.5)	1	25	0	25 (63)
		1.2 mm, SupraMig® S-6	80% Ar / 20% CO_2	95 (2.4)	1	10	0	25 (63)
			100% CO_2	95 (2.2)	1	10	0	25 (63)
24 Ga	0.65 mm	0.035 in, SuperArc® L-56	75% Ar / 25% CO_2	110 (2.7)	1	40	0	20 (51)
			100% CO_2	90 (2.2)	1	40	0	20 (51)
		1.0 mm, SupraMig® S-6	80% Ar / 20% CO_2	95 (2.4)	1	30	0	20 (51)
			100% CO_2	80 (2.0)	1	30	0	20 (51)
		0.045 in, SuperArc® L-56	75% Ar / 25% CO_2	90 (2.2)	1	10	0	20 (51)
			100% CO_2	85 (2.1)	1	10	0	20 (51)
		1.2 mm, SupraMig® S-6	80% Ar / 20% CO_2	80 (2.0)	1	0	0	20 (51)
			100% CO_2	75 (1.9)	1	0	0	20 (51)

Lap Weld Procedures

GAP (0.5 mm)	
Travel Angle	10-20° Push
Work Angle	40-50°
CTWD	
0.625 in	15 mm





NOTE: For lap weld procedures with a gap, position the electrode directly into the joint.

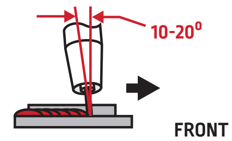
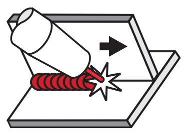
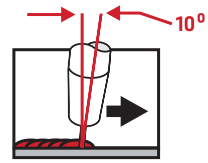


PLATE THICKNESS		WIRE	GAS	WFS in/min (m/min)	TRIM	BALANCE	ULTIMARC	TRAVEL SPEED in/min (cm/min)
18 Ga	1.3 mm	0.035 in, L-56	75% Ar / 25% CO_2	200 (5.0)	1	60	0	25 (63)
			100% CO_2	185 (4.6)	1	60	0	25 (63)
		1.0 mm, S-6	80% Ar / 20% CO_2	180 (4.5)	1	50	0	25 (63)
			100% CO_2	165 (4.0)	1	50	0	25 (63)
		0.045 in, L-56	75% Ar / 25% CO_2	160 (4.1)	1	40	0	25 (63)
			100% CO_2	150 (3.8)	1	40	0	25 (63)
		1.2 mm, S-6	80% Ar / 20% CO_2	145 (3.6)	1	30	0	25 (63)
			100% CO_2	135 (3.4)	1	30	0	25 (63)
20 Ga	1.0 mm	0.035 in, L-56	75% Ar / 25% CO_2	155 (3.9)	1	50	0	25 (63)
			100% CO_2	140 (3.5)	1	50	0	25 (63)
		1.0 mm, S-6	80% Ar / 20% CO_2	140 (3.5)	1	40	0	25 (63)
			100% CO_2	130 (3.3)	1	30	0	25 (63)
		0.045 in, L-56	75% Ar / 25% CO_2	125 (3.1)	1	20	0	25 (63)
			100% CO_2	115 (2.9)	1	20	0	25 (63)
		1.2 mm, S-6	80% Ar / 20% CO_2	115 (2.9)	1	10	0	25 (63)
			100% CO_2	105 (2.6)	1	10	0	25 (63)
22 Ga	0.8 mm	0.035 in, L-56	75% Ar / 25% CO_2	130 (3.3)	1	40	0	20 (51)
			100% CO_2	105 (2.6)	1	40	0	20 (51)
		1.0 mm, S-6	80% Ar / 20% CO_2	115 (2.9)	1	30	0	20 (51)
			100% CO_2	105 (2.6)	1	20	0	20 (51)
		0.045 in,. L-56	75% Ar / 25% CO_2	95 (2.4)	1	10	0	20 (51)
			100% CO_2	90 (2.2)	1	10	0	20 (51)
		1.2 mm, S-6	80% Ar / 20% CO_2	85 (2.1)	1	0	0	20 (51)
			100% CO_2	80 (2.0)	1	0	0	20 (51)
24 Ga	0.65 mm	0.035 in, L-56	75% Ar / 25% CO_2	105 (2.6)	1	20	0	20 (51)
			100% CO_2	90 (2.2)	1	20	0	20 (51)
		1.0 mm, S-6	80% Ar / 20% CO_2	95 (2.4)	1	20	0	20 (51)
			100% CO_2	85 (2.1)	1	20	0	20 (51)
		0.045 in, L-56	75% Ar / 25% CO_2	85 (2.1)	1	10	0	20 (51)
			100% CO_2	80 (2.0)	1	10	0	20 (51)
		1.2 mm, S-6	80% Ar / 20% CO_2	75 (1.9)	1	0	0	20 (51)
			100% CO_2	70 (1.7)	1	0	0	20 (51)

Fillet Weld Procedures

NO GAP	
Travel Angle	15° Push
Work Angle	50°
CTWD	
0.625 in	15 mm





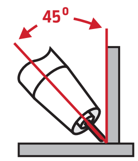
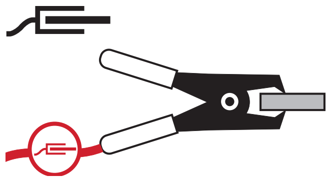


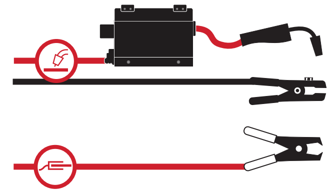
PLATE THICKNESS		WIRE	GAS	WFS in/min (m/min)	TRIM	BALANCE	ULTIMARC	TRAVEL SPEED in/min (cm/min)
18 Ga	1.3 mm	0.035 in, L-56	75% Ar / 25% CO_2	185 (4.6)	1	100	0	25 (63)
			100% CO_2	165 (4.0)	1	100	0	25 (63)
		1.0 mm, S-6	80% Ar / 20% CO_2	160 (4.1)	1	100	0	25 (63)
			100% CO_2	160 (4.1)	1	100	0	25 (63)
		0.045 in, L-56	75% Ar / 25% CO_2	135 (3.4)	1	80	0	25 (63)
			100% CO_2	130 (3.3)	1	70	0	25 (63)
		1.2 mm, S-6	80% Ar / 20% CO_2	120 (3.0)	1	70	0	25 (63)
			100% CO_2	115 (2.9)	1	70	0	25 (63)
20 Ga	1.0 mm	0.035 in, L-56	75% Ar / 25% CO_2	155 (3.9)	1	60	0	25 (63)
			100% CO_2	130 (3.3)	1	80	0	25 (63)
		1.0 mm, S-6	80% Ar / 20% CO_2	135 (3.4)	1	60	0	25 (63)
			100% CO_2	120 (3.0)	1	70	0	25 (63)
		0.045 in, L-56	75% Ar / 25% CO_2	115 (2.9)	1	60	0	25 (63)
			100% CO_2	100 (2.5)	1	60	0	25 (63)
		1.2 mm, S-6	80% Ar / 20% CO_2	105 (2.6)	1	50	0	25 (63)
			100% CO_2	90 (2.2)	1	50	0	25 (63)
22 Ga	0.8 mm	0.035 in, L-56	75% Ar / 25% CO_2	115 (2.9)	1	50	0	20 (51)
			100% CO_2	95 (2.4)	1	70	0	20 (51)
		1.0 mm, S-6	80% Ar / 20% CO_2	100 (2.5)	1	50	0	20 (51)
			100% CO_2	80 (2.0)	1	60	0	20 (51)
		0.045 in,. L-56	75% Ar / 25% CO_2	85 (2.1)	1	50	0	20 (51)
			100% CO_2	75 (1.9)	1	60	0	20 (51)
		1.2 mm, S-6	80% Ar / 20% CO_2	75 (1.9)	1	50	0	20 (51)
			100% CO_2	70 (1.7)	1	50	0	20 (51)

Sense Leads

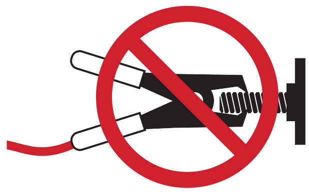
A work (-) sense lead is required and should be connected directly to the workpiece without being in the path of current flow.



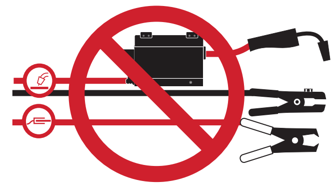
The work (-) sense lead should be separated away from welding cables to minimize interference.



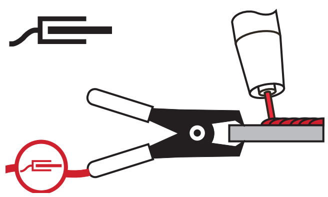
DO NOT connect either sense lead to a welding stud as this may result in erratic arc or increased spatter.



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



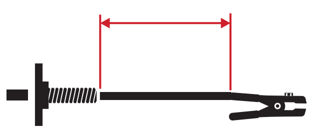
For best performance, connect the work (-) sense lead close to the welding arc.



For non-Lincoln Electric Power Feeders assistance, call the Lincoln Electric Application Engineering Group staffed by experienced engineers, technologists and technicians in Cleveland, OH, USA at +1 866 635 4709.

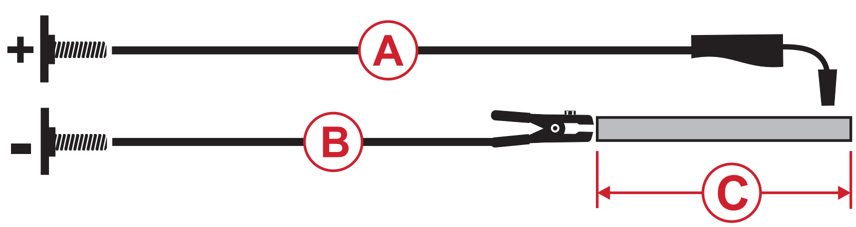
Work Leads

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

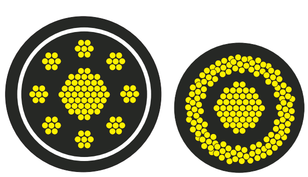


Test cable inductance levels using the Power Wave® Manager software exclusively from Lincoln Electric® Software. Available at www.powerwavesoftware.com.

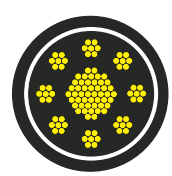
The total length of the welding current loop (A+B+C) should be minimized to reduce inductance. Route cables (A,B) close together to further reduce cable inductance.



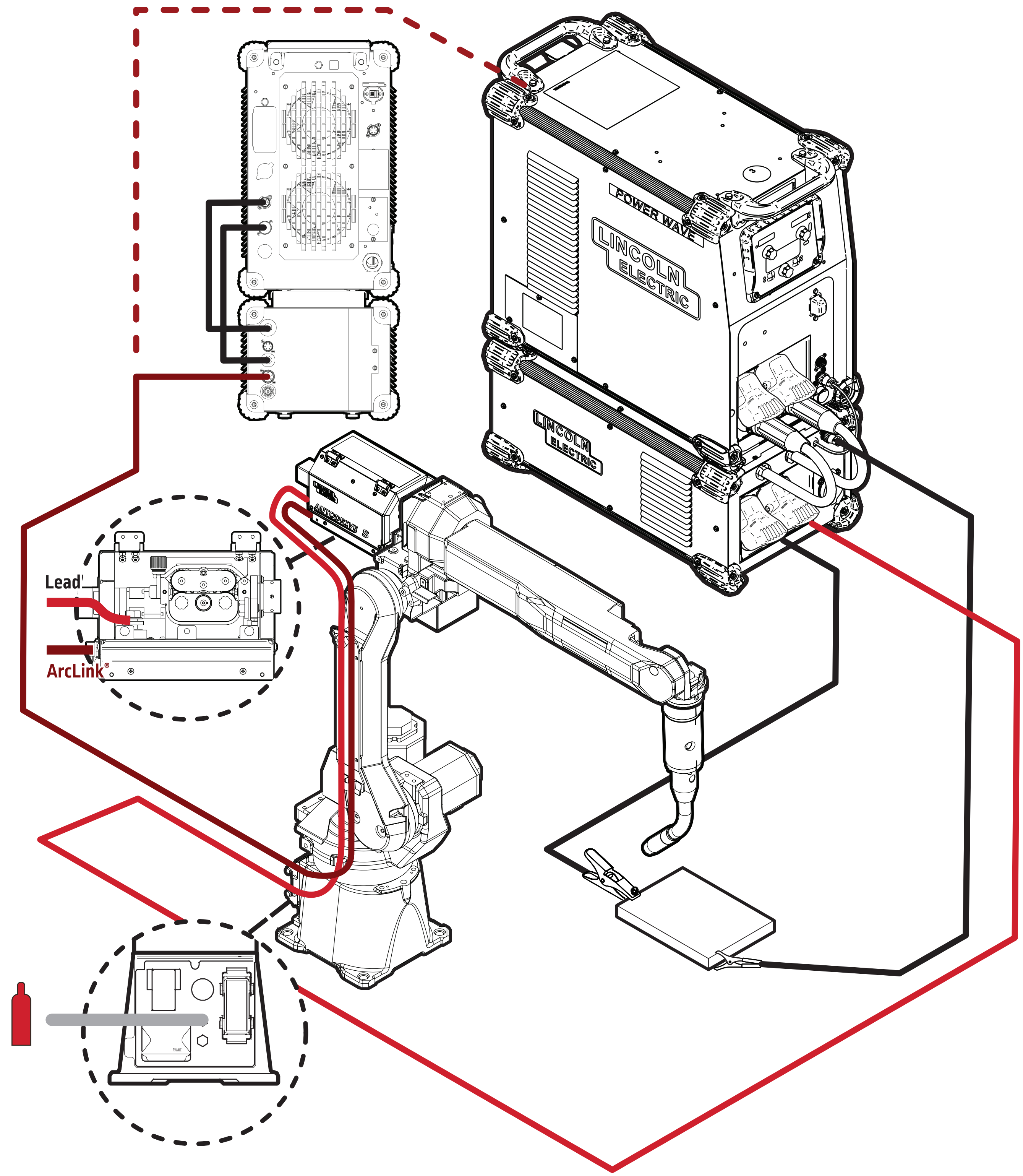
For configurations with excessive inductance, use Lincoln Electric® patented coaxial welding cables.



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



Connection Diagram – Advanced Module



Troubleshooting

SPATTER								
Check	Volts	Travel Speed	Contact Tip to Work Surface	Wire Feed Speed	Gas Coverage	Push Angle	UltimArc®	Work Sense Lead
Action	Increase !	Decrease !	Decrease	Decrease	Inspect & Replace	Decrease	Increase	Inspect & Replace

ERRATIC ARC								
Check	Travel Speed	Proper Feeding	Trim	Wire Feed Speed	Push Angle	Tip	Surface Contaminates	Work Sense Lead
Action	Decrease !	Inspect & Replace !	Increase	Decrease	Decrease	Inspect & Replace	Inspect & Replace	Inspect & Replace

POROSITY			
Check	Gas Coverage	Surface Contaminates	Contact Tip to Work Surface
Action	Increase !	Inspect & Replace !	Decrease

CONCAVE BEAD				
Check	Volts	Wire Feed Speed	Contact Tip to Work Surface	Push Angle
Action	Decrease !	Increase !	Increase	Increase

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

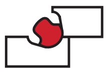
Increase

Decrease

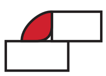
Inspect & Replace

Important

Troubleshooting

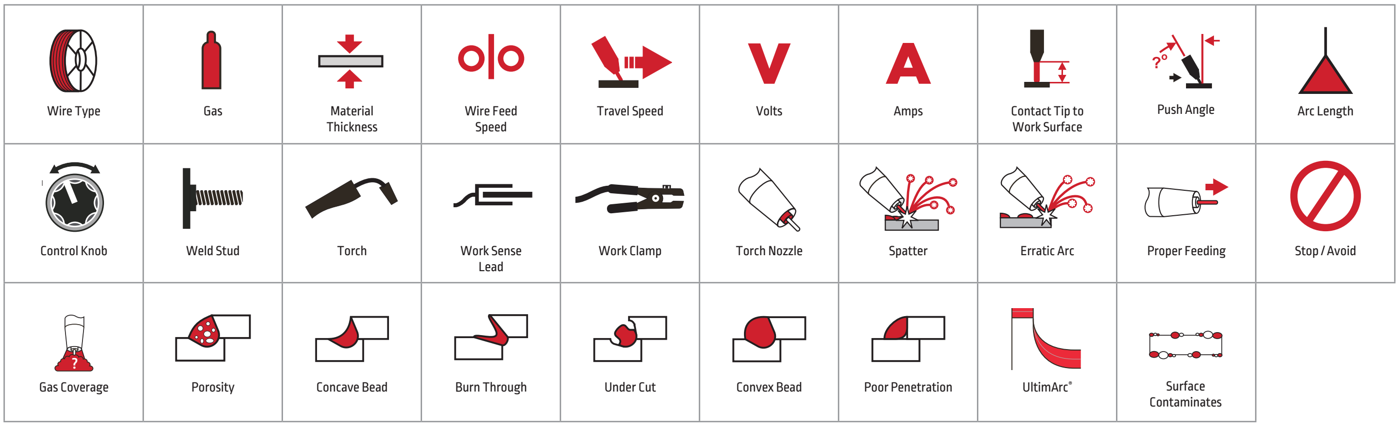
 UNDER CUT	Check ▶	Volts	Travel Speed	Wire Feed Speed
	Action ▶	↓ − !	↓ − !	↓ −

 BURN THROUGH	Check ▶	Balance	Travel Speed	Wire Feed Speed	Contact Tip to Work Surface	Push Angle
	Action ▶	↓ − !	↑ + !	↓ − !	↑ +	↑ +

 POOR PENETRATION	Check ▶	Balance	Travel Speed	Wire Feed Speed	Contact Tip to Work Surface	Push Angle
	Action ▶	↑ + !	↓ − !	↑ + !	↓ −	↓ −

↑ + Increase	↓ − Decrease	Inspect & Replace	! Important

Icons



Technical Terms

Cable Inductance	Resistance to change in current. Should not exceed 65 μH.
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 preprogrammed 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.