

# Tandem Wire MIG Welding

*Heavy deposition welding  
at increased welding speed*





Skilled welders are getting harder to find and keep. Fabricators must reduce costs and use production time more efficiently. Investing in technology will help make this happen. Technology is being used to replace people when their ability to meet goals is slowed by unproductive processes. Small manufacturers can see the benefits of a robotic cell that consistently welds with the aid of a skilled operator. The next logical step is to focus on

maximizing the output of the robot.

Tandem Wire MIG welding, also known as high speed welding, is when each electrode has a separate contact tube electrically insulated from each other. This allows each electrode to have different electrical potentials and has always been viewed as a desirable but problematic process. Initially, high speed welding cells sacrificed accuracy, repeatability and consistency for speed and usually resulted in higher scrap rates. As you went faster, it became more critical to be accurate and control each and every variable. Man cannot adjust to the intense heat and high deposition rate demands of the process but robots were the perfect answer. The biggest advantage of robots in high speed welding is their capability of welding complex shapes at high speed.

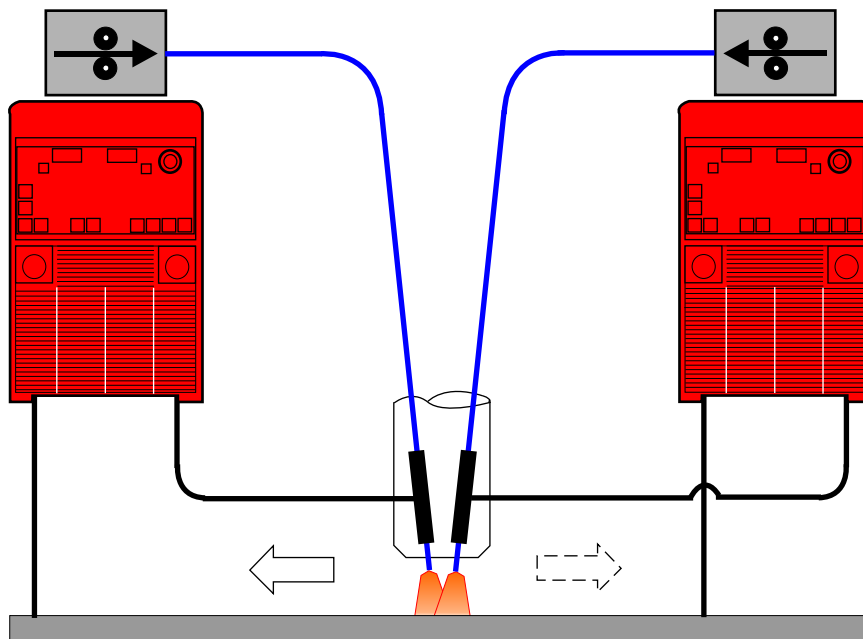


Figure 1. Tandem welding with two contact tubes electrically insulated from each other.

#### How does it work?

The Lead arc provides control of the penetration, while the Trail arc controls bead appearance. Both electrodes contribute to a common weld puddle but each is independently controlled by their respective power sources. It is also possible to use just one electric arc to perform single wire welding.

For maximum flexibility, the Wolf Robotics Tandem Wire MIG Welding System torch can track in either direction, reducing cycle time, with either wire using both solid and metal cored wires of different diameters independently or at the same time. It's possible to choose Standard or Pulsed Arc independently to fit one of the four variants depending on desired results.

Pulsed/Pulsed mode: Both Lead and Trailing arcs operate in a synchronized pulsed mode so that the peak of each pulse occurs on the background of the other arc (dependent on power supply capability). The most common variant.

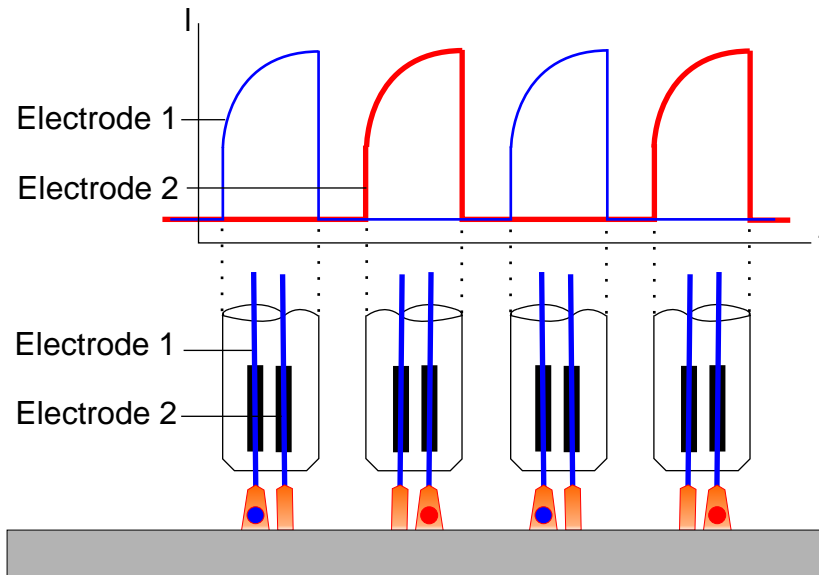


Figure 2. Tandem pulsed electric arc process (180 phase-shifted).

Pulsed/Standard mode: Lead arc is synchronized pulsed while the Trailing arc is Constant Voltage for achieving maximum welding speed and gap bridging.

Standard/Pulsed mode: Best for deep penetration the Lead arc is in Constant Voltage mode which maximizes penetration and travel speed while the Trailing arc is in pulse mode to reduce heat input and cool the weld puddle.

Standard/Standard mode: Lead and Trailing arcs are both in Constant Voltage mode usually for welding with just one electrode and switching to the other when changing directions to reduce cycle time.

### Benefits

- Maximum deposition efficiency (40% to 80% increase over single-wire)
- Doubles production speed or better
- Direction of process is independent
- Have capability to track in either direction with either wire (leading or trailing) for maximum flexibility with creating programs and doing off-line programming. Allows full advantage of robots working range.
- Capable of tracking off either wire
- Lowers production costs
- Increases productivity

### Advantages

- High welding speeds
- Faster cycle times
- Reduced heat input
- Resists burn-through on thin materials
- Low spatter levels
- Good penetration on thick materials

## Typical applications

Cylinders, tanks, water heaters, lawn and garden equipment, gussets and stiffeners, off-road equipment, construction equipment and agricultural machinery, ASME tanks, joggle joints, pipe and tubular components.

## Tandem Wire MIG Welding Equipment

The dual wire, GMAW automated process uses two separately controlled power sources, two independent but synchronized wire feeders, two insulated wire electrodes that generate two separate welding arcs in one single gas nozzle and one shared weld pool. Figure 3 demonstrates the basic components of an automated application.

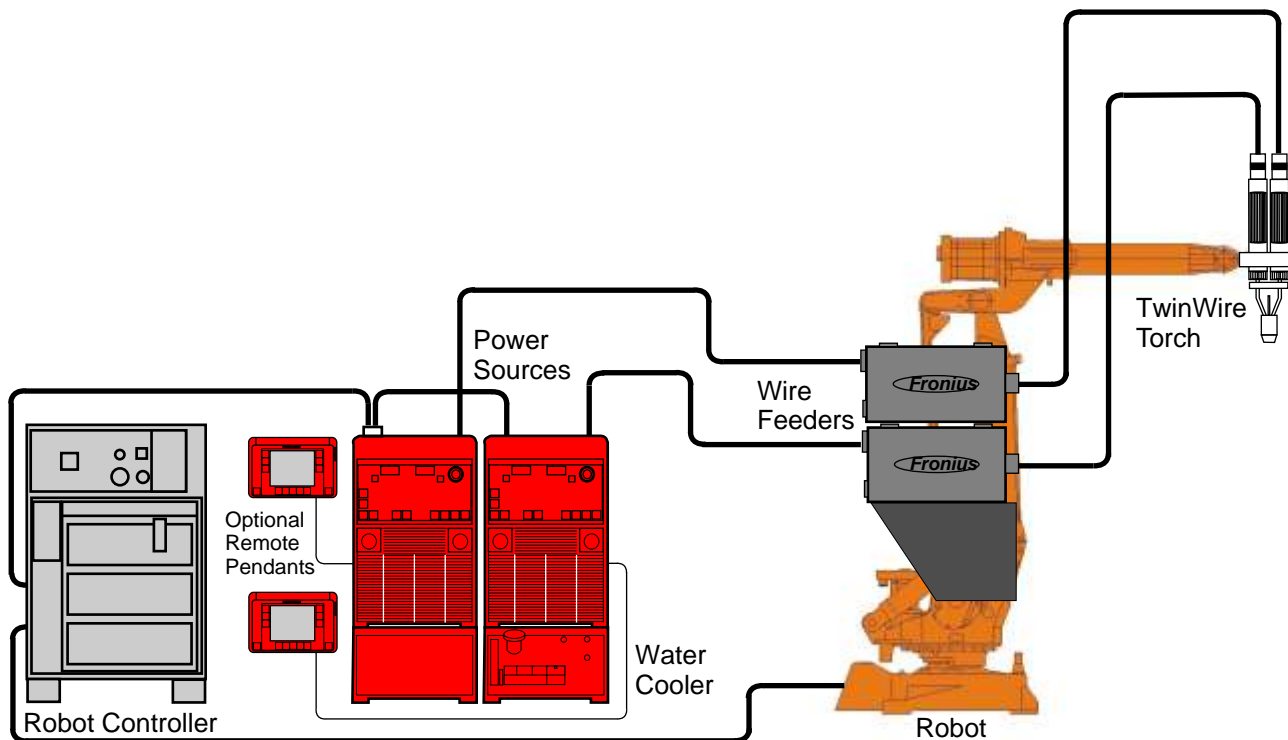


Figure 3. Basic diagram of standard tandem welding components in an automated application.

### Power Sources -

Tandem-Wire welding made substantial advances when power sources were converted to digital technology. Now it was possible to control the welding process in a completely digital manner, which yielded considerable benefits:

- Small and compact electronics.
- Flexible system control of the welding arc
- Long term stability not affected by temperature drifts

It was vital that the two power sources communicate with each other for the synchronization of the two electric arcs. An additional requirement was that the robot could activate the two power sources as a single power source.

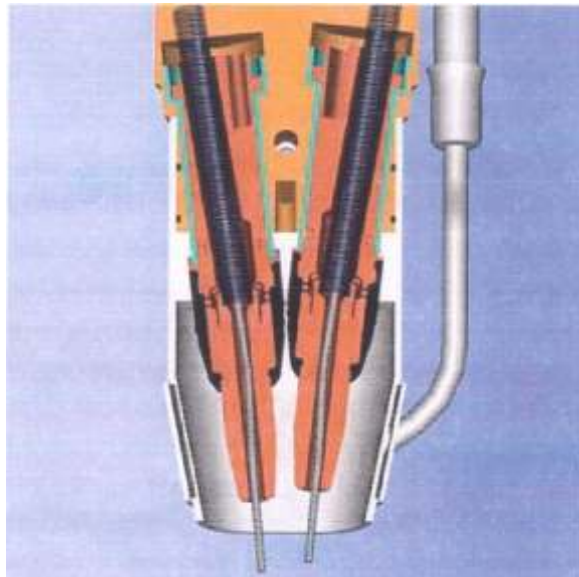
### Wire Feeders -

Advancing two welding wire electrodes requires two wire feeder mechanisms that each advance one electrode. In the automated process it's important that the wire feeders are capable of unwinding wire from large and drum coils in a manner that also straightens the wire.

### Welding Torch -

Two wire electrodes electrically insulated from one another must run through a common gas nozzle and share a common welding torch. Because a lot of heat is generated in this process it must be subsequently dissipated all the way to the front area of the contact tubes.

Torches are available in a slim-line construction model where the wire feeder mounts close to the torch (usually on or next to the robot arm) to minimize distance of wire travel and a push-pull design that incorporates an additional wire advancing mechanism in the torch when the wire feeder is farther away and/or softer wire is being used (i.e. aluminum, etc.).



*Figure 4. Welding torch detail view with two contact tubes electrically insulated from each other.*



*Figure 5. Typical push-pull welding torch model and slim-line welding torch model.*

## Welding Speeds and Deposition Rates

Tandem welding allows you to increase the deposition rate into a greater cross sectional area of the seam or achieve higher welding speeds. Increase in welding speed is usually of chief significance. Actual increase factors depend on material, thickness of sheet metal, geometry of the seam, welding position, etc. In general, welding speed can be increased by a factor of 2-3 with welding speeds up to 275 ipm and deposition rates of up to 66 lbs/hr steel.

	Shouldered overlap joint	Overlap joint	Throat seam, horizontal	Throat seam, horizontal
Sheet metal thickness (in.)	.078"	.118"	.236"	.393"
Welding position	PA	PB	PB	PB
Wire diameter	.045"	.045"	.045"	.045"
Wire advancement speed (ipm) single-wire / twin-wire	390-470 / 350-430	390-510 / 350-470	470-550 / 430-510	630-700 / 590-670
Welding speed (ipm)	100 - 120	60 - 100	50 - 60	40 - 50
Protective gas in accordance with EN 439	I 1 or I3 (argon or argon-helium mixtures)	I 1 or I3 (argon or argon-helium mixtures)	I 1 or I3 (argon or argon-helium mixtures)	I 1 or I3 (argon or argon-helium mixtures)

Table 1. Typical values for aluminum welding speeds and deposition rates.

	Shouldered overlap joint	Overlap joint	Butt joint	Throat seam, horizontal	Throat seam, downhand position
Sheet metal thickness (in.)	.078"	.118"	.118" PA	.393"	.393"-.787"
Welding position	PA	PB	PA	PB	PA
Wire diameter	.039"	.045"	.045"	.045"	.045"
Wire advancement speed (ipm) single-wire / twin-wire	550-630 / 470-550	350-470 / 275-390	350-470 / 275-390	470-550 / 430-510	590-700 / 550-670
Welding speed (ipm)	100 - 140	60 - 100	60 - 80	40 - 50	25 - 65
Protective gas in accordance with EN 439	All M2s, with or without He M 21 or M21 (1) having approx. 10% CO <sub>2</sub>	All M2s, with or without He M 21 or M21 (1) having approx. 10% CO <sub>2</sub>	All M2s, with or without He M 21 or M21 (1) having approx. 10% CO <sub>2</sub>	All M2s, with or without He M 21 or M21 (1) having approx. 10% CO <sub>2</sub>	All M2s, with or without He M 21 or M21 (1) having approx. 10% CO <sub>2</sub>

Table 2. Typical values for steel welding speeds and deposition rates.

Basic material	Protective gas
Non-alloy and low-alloy steel / pulse welding	90% Ar / 10% CO <sub>2</sub> or 82% Ar / 18% CO <sub>2</sub>
Non-alloy and low-alloy steel / standard welding	95-98% Ar / 2-5% O <sub>2</sub>
Aluminum / pulse welding	Ar or Ar / He mixture
Stainless steel / pulse welding	97.5% Ar / 2.5% Co <sub>2</sub>

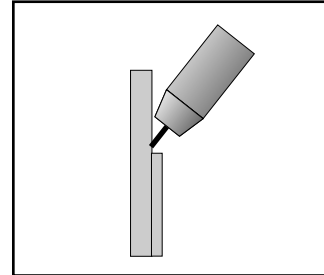
Table 3. Protective gases used for various basic materials and electric arc types.

## Technology Innovations

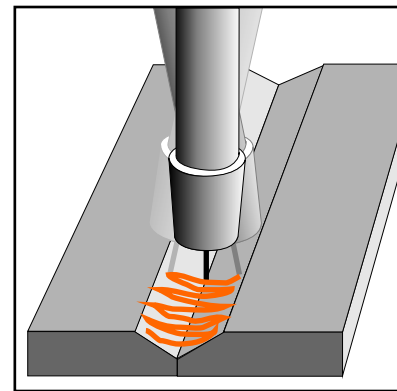
Even though Tandem Wire MIG welding has been integrated with robotics for some time, we have not realized the maximum output of the process until recently when robotics were finally able to incorporate proper and accurate sensing of the weld joint and its variables.

Three types of sensing are now available to assist the robot in compensating for the changes in part fit-up and keeping the equipment operational.

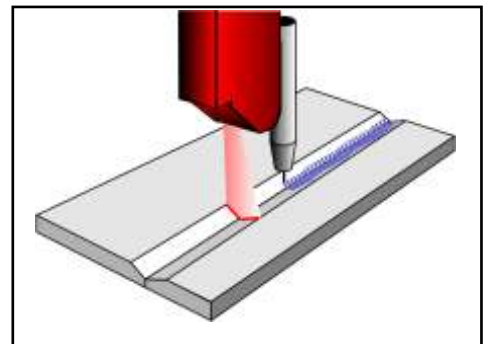
AWC Thru-the-arc - monitoring works best on single sided lap joints and should be done with the lead wire for best tracking capability in either direction.



Calculated adaptive - uses tactile sensing to determine joint width and weave pattern.



Servo Robot Camera adaptive - for precision volumetric fill when joint width fluctuates extremely. The camera's physical size should be considered when accessing the weldment.



In addition to the sensing capabilities described there is also the option of maintaining automated calibration of the robot and welding torch.

BullsEye calibration unit Helps maintain an accurate Tool Center Point (TCP) torch alignment for consistent quality by measuring wire stickout at the torch and adjusting the program automatically to compensate for changes.



## TECHNICAL DATA

	TPS 4000	TPS 5000
Mains Voltage	3x460V / 50-60 Hz	3x460V / 50-60 Hz
Mains fuse slow	35 A	35 A
Cos phi (270 A)	0,99	0,99
Efficiency	89 %	88 %
Welding current range	3-400 A	3-500 A
Welding current at 10 Min/40 C 50% d.c.	400 A	500 A
10 Min/40 C 60% d.c.	365 A	450 A
10 Min/40 C 100 % d.c.	320 A	360 A
Open-circuit voltage	70 V	70 V
Open-circuit power	55 W	55 W
Operating voltage	14.2 -34.0 V	14.2 -39.0 V
Degree of protection	IP 23	IP 23
Type of cooling	AF	AF
Dimensions l/w/h	24.61" x 11.42" x 18.89" (625 / 290 / 480 mm)	24.61" x 11.42" x 18.89" (625 / 290 / 480 mm)
Weight	77.6 lbs. (35.2 kg)	78.4 lbs. (35.6 kg)

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