TOPTIG®

Overview

TOPTIG® TIG Quality –
Advanced Robotic GTAW

- Low Noise, Low Fume, Spatter Free
- High Quality Welds at Higher Speeds
- Unmatched Consistency

Index

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Process Comparison

TOPTIG® vs. Conventional Robotic TIG

TOPTIG® allows the user to program a robot without the issues typically present in robotic GTAW welding. No need to change torch angles to accommodate an external wire tube. With the wire guide tube being integrated into the gas nozzle, the user does not have to be concerned with wire relationship changing. With TOPTIG®, wire can be fed in from any direction because of this. A smaller, more compact, design allows the TOPTIG® torch to be used in more confined spaces.

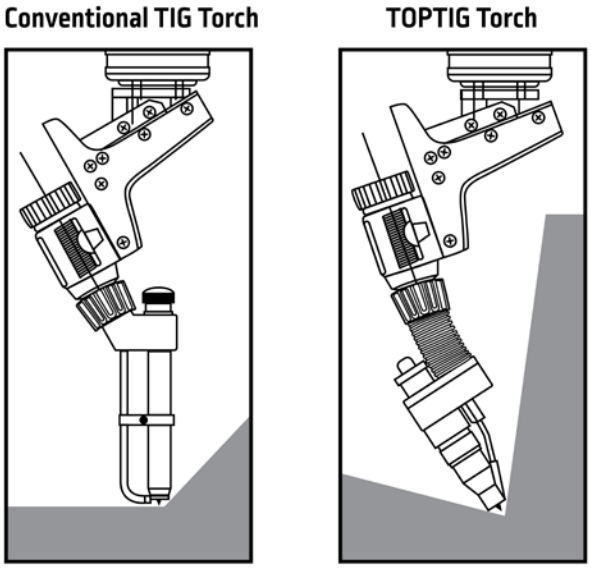


Figure 1: A conventional robotic TIG torch (left) compared to the TOPTIG® torch (right).

TOPTIG®Wire Positon & Weld Direction

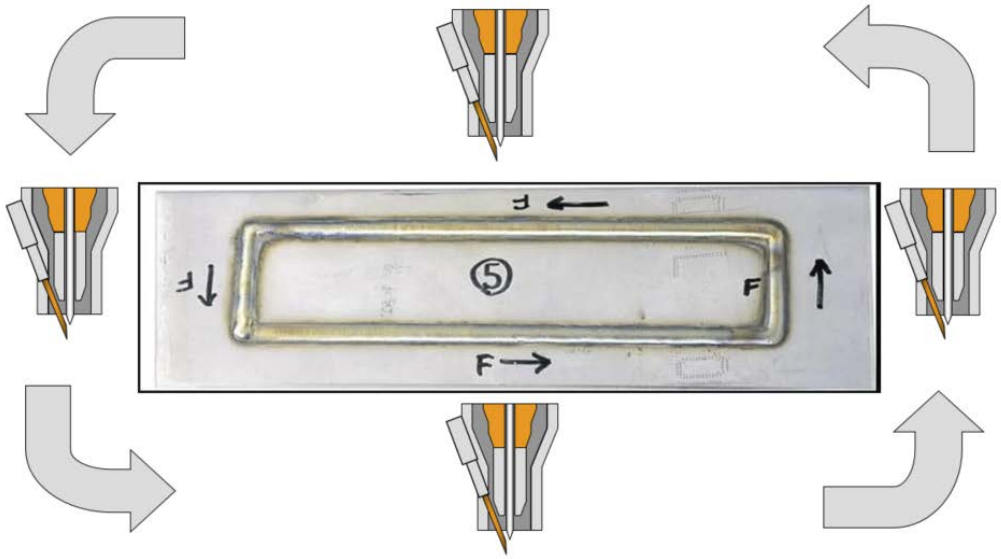


Figure 2: Diagram showing wire position in relation to wire welding direction.

Modes of Transfer

TOPTIG® utilizes two modes of transfer to deposit metal into the joint, droplet transfer and liquid bridge.

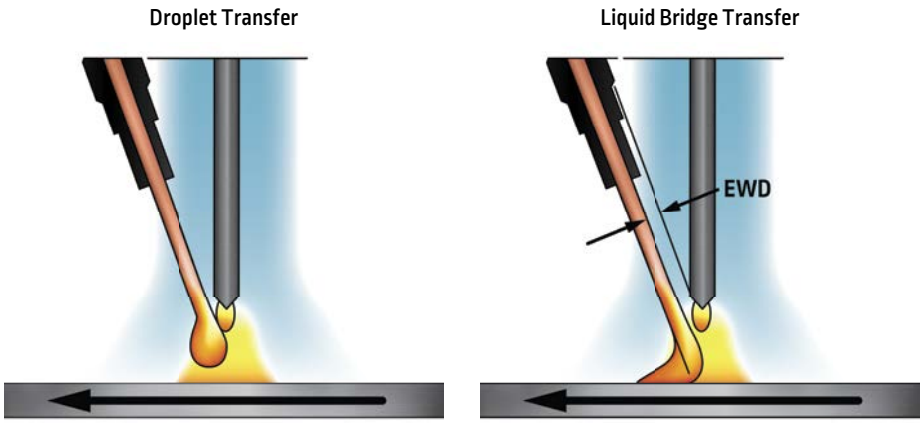


Figure 3: A diagram illustrating the difference between Droplet Transfer (left) and Liquid Bridge transfer (right).

Droplet transfer mimics traditional TIG by adding wire to the puddle then retracting it, causing a droplet to form and go into the puddle. This type of transfer works well when welding aluminum and thicker materials.

Liquid Bridge transfer continuously feeds wire into the weld puddle causing the wire to melt as it meets the puddle. This type of transfer allows for faster travel speeds that approach GMAW welding speeds. It is typically recommended on thinner materials.

TOPTIG® Fab-Pak®

The TOPTIG® Fab-Pak® is a standard Lincoln Electric robotic cell solution that delivers a complete, ready-to-weld package for easy ordering, simple set-up, and straightforward operation.

INCLUDES:

TOPTIG® Torch

The TOPTIG® torch is available with both a water cooled and air cooled nozzle option. The torch can be mounted directly to the FANUC® ServoTorch to provide quick changeover when required.

Power Wave® R450 with Advanced Module

A multi-process power supply capable that can be used for a variety of robotic applications. Provides seamless integration with the robotic interface by using ArcLINK®.

Cool Arc® 55S Water Cooler*

Designed to integrate directly with the Power Wave® S-Series power sources,the Cool Arc® 55S is a rugged, reliable water cooler capable of cooling torches rated up to 500 amps, as well as prohibit welding if no flow is detected.

Only required when a water cooled nozzle is in use.

ADDITIONAL REQUIRED EQUIPMENT:

Reel Stand with Conduit Bracket & Conduit

For use with Lincoln Electric 10-60 lb. (4.5-27.2 kg) wire packages that use a 2 in. (51 mm) spindle. Hole in stand fits over lift bail. Lincoln Electric's polymer conduit is durable, has a low friction coefficient, and provides much less pull on the feed motor than metal-lined conduit.

Tungsten

Lincoln Electric offers tungsten electrode and the available types include 2% Lanthanated (EWLa2), 2% Ceriated (EWCe2) and WX Multi Oxide (EWG); each offered in multiple diameters to provide a strategic tungsten solution for all amperages and both AC & DC currents.

Precision Tungsten Grinder*

FA precision tungsten grinder is recommended for preparing any tungsten used with TOPTIG®. An example of a precision tungsten grinder would be the Sharpshooter Precision Tungsten grinder.

Any precision tungsten grinder can be used as long as it is repeatable and reliable.

Wire Guide Tube – in.(mm)	Part #
0.030 (0.8)	W000267694
0.035 (0.9)	W000373557
0.040 (1.0)	W000267695
0.045 (1.2)	W000267696
1/16 (1.6)	W000374519

Tungsten Collet – in.(mm)	Part #
3/32 (2.4)	W000315903
1/8 (3.2)	W000315904
3/16 (4.0)	W000315905

Part	Part #
1/2 in. Air-cooled Nozzle	W000315627
3/8 in. Water-cooled Nozzle	W000271180
3/4 in. Water-cooled Nozzle	W000275860

Part	Part #
Electrode Holder	W000315620

Part	Part #
Liner, Polymer, 2.3mm [0.9 in] ID	AD1329-583
Neck/Outlet Liner 0.35-.047	S22645-805
Conduit Couplet In & Out	S22645-180
Insulating Cap	W000315624

Part	Part #
Wire Guide Tool	W000315625

Part	Part #
Electrode Tool	W000315618

	Drive Rolls – in.(mm)	Part #
Fanuc Servo Torch™ V-Groove	0.030 (0.8)	AD1194-32
	0.035 (0.9)	AD1194-33
	0.045 (1.1)	AD1194-117
Fanuc Servo Torch™ U-Groove	0.030 (0.8)	AD1194-28
	0.035 (0.9)	AD1194-29
	0.047 (1.2)	AD1194-30
	1/16 (1.6)	AD1194-31

Installing the TOPTIG® Torch

The Lincoln TOPTIG® torch connects directly Fanuc Servo Torch™. Due to periodic maintenance, the torch will be required to be removed from the servo torch and can be reattached using the following steps. Align the water cooling connections and seat the torch. Once the torch is seated, tighten the nut to secure the torch in place.

Changing the Gas Nozzle on the TOPTIG Torch

To change the nozzle on the TOPTIG torch, the following steps below should be followed.

Air Cooled Nozzle

1. Remove the tungsten from the torch. This step is optional but should be done to prevent any potential issues.
2. Remove the nut and bolt that hold the grounding cable in the nozzle.
3. Unscrew the threaded connection at the top of the nozzle. Once the connection is fully unthreaded, slide the nozzle off of the end of the torch.
4. Slide the new nozzle on to the end of the torch and thread on the new nozzle. Take care to not cross thread the nozzle.
5. Attach the nozzle grounding cable to the nozzle using the nut and bolt that was originally removed.

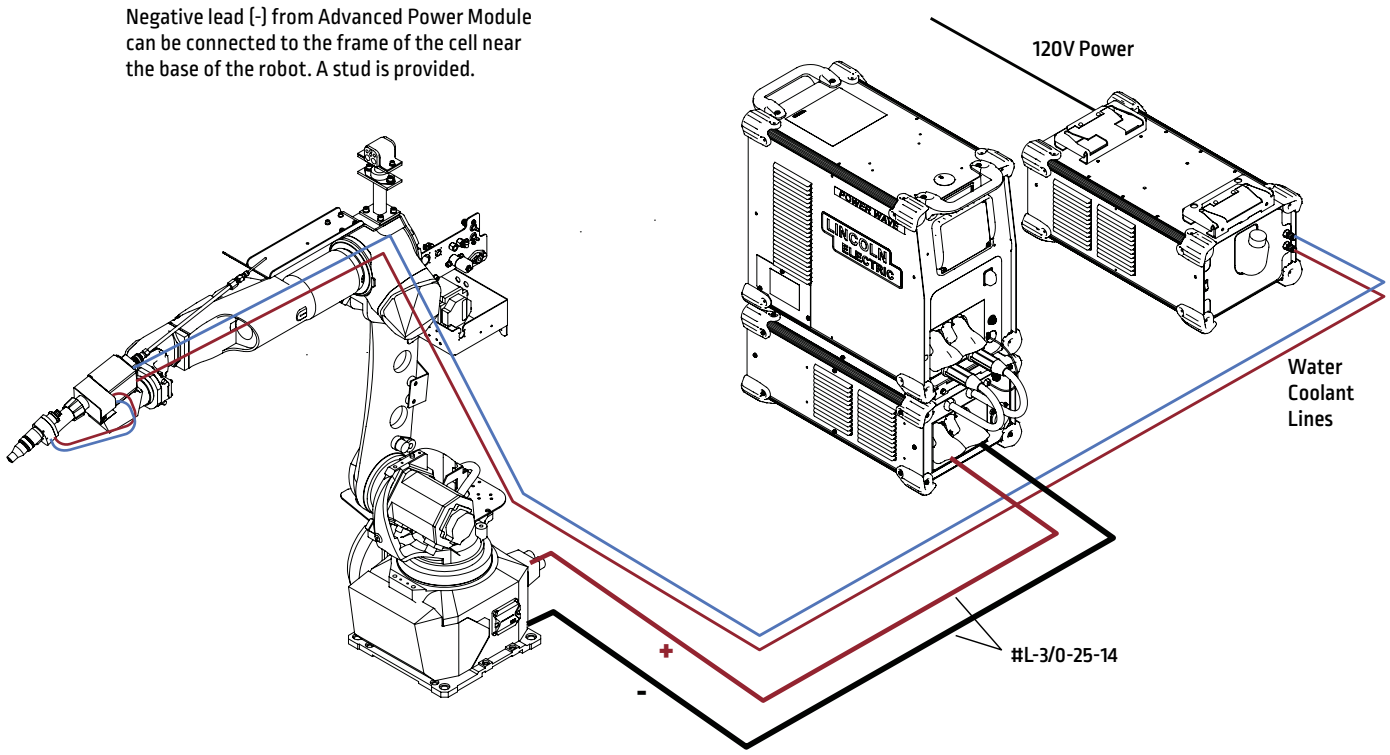
Water-Cooled Nozzle

1. Remove the tungsten from the torch. This step is optional but should be done to prevent any potential issues.
2. Verify that the water cooler for the nozzle is off.
3. Remove the nut and bolt that hold the grounding cable in the nozzle
4. Unscrew the threaded connection at the top of the nozzle. Once the connection is fully unthreaded, slide the nozzle off of the torch and support.
5. Disconnect the two quick disconnects for the water lines and set the nozzle aside.
6. Connect the water lines for the new nozzle to the quick connects.
7. Slide the new nozzle on to the end of the torch and thread on the new nozzle. Take care to not cross thread the nozzle.
8. Attach the nozzle grounding cable to the nozzle using the nut and bolt that was originally removed.

Cable Routing and Equipment Shielding

Prior to welding, it is important to check all of the connection and make sure that they are in good working order. It is also recommended that you make sure the high frequency resistor is properly attached to the ground to ensure that the nozzle is properly discharged and prevent potential starting issues. See the figures below on how to connect and route cables.

Connection Diagram



Tungsten Preparation and Installation

Tungsten preparation should only done using a precision tungsten grinder. The steps below should be followed regardless of tungsten grinder used. Only Tungsten's 6 in. (150 mm) in length and shorter can be used with the TOPTIG® Torch, as longer tungsten will prevent the tungsten length from being set properly.

1. If using a Lincoln Electric tungsten over 6 in. (150 mm) in length, remove the excess length using the cutoff wheel on the precision tungsten grinder.
2. Verify that the proper grind angle is set on the grinder. If it is not set to the appropriate grind angle, adjust the grinder to the correct angle
3. Grind the tungsten and remove the tip of the electrode
4. Verify that the proper tungsten collet is in the electrode holder
5. Place the tungsten into the electrode holder and set proper tungsten length. Make sure the top edge of the end of the tungsten holder is flush with the electrode tool.

6. Place electrode holder into the TOPTIG® torch and secure.

Heat Wave Sync™ and Low Frequency Pulse

Heat Wave Sync™ is a software that is available from FANUC® and allows for wire syncing. This software also allows for wire sync, meaning that the user doesn't need to sync the wire to the amperage pulsing. Low Frequency Pulse is another FANUC® feature, which allows the wire to be pulse and slower intervals than what is done in GMAW welding. When Heat Wave Sync™ and Low Frequency Pulse are active the user has the ability to set to additional weld settings:

- Amperage Peak – Amperage when the wire is added to the puddle.
- Amperage Base – Amperage when the wire is retracted from the puddle.
- Wire Feed Speed Peak – Wire Feed Speed when the wire is added to the puddle.
- Wire feed Speed Base – Wire Feed Speed when the wire is retracted from the puddle.
- Pulse Duty Cycle – The number of pulses per second
- % on Time – The time (%) at the Amperage peak and Wire Feed Speed Peak.

Selecting the Proper Wire

When welding with the TOPTIG® process, the choice of wire is very important. The use of a wire with consistent cast and helix is strongly recommended to produce consistent results. Since the wire and tungsten are in such close proximity to one another, any variation in wire placement can cause unfavorable results like wire stubbing or tungsten contamination. This will lead to downtime on the cell and potential rework of the affected part. Lincoln Electric branded filler materials are made to stringent manufacturing specifications that provide the consistency needed to prevent these potential issues. The steps listed below should be followed depending on the type of material to be welded.

Steel

When welding steel, it is important to use a filler metal with as low of a silicon content as possible. An example of this would be using SuperArc® L-52 over SuperArc® L-56 when a 70Ksi wire is required to be used. This may not always be possible but should be followed when possible. Lubrication on the wire can also cause adverse puddle interactions so a wire minimum or no lubrication should be used.

Stainless Steel

When welding stainless steel, a filler metal that does not have any added silicon should be used. An example of this would be using an ER308L filler metal instead of an ER308LSi filler metal. If a wire with added silicon is used the puddle can interfere with the welding arc and cause instability. This may cause wire stubbing and result in the torch moving.

Aluminum

When welding aluminum, it is important to use the largest wire diameter possible. By using a larger diameter wire, it prevents the wire from melting and balling up prior to reaching the weld puddle. Also by preventing the wire from balling up, it will prevent possible tungsten contamination from the wire touching the tungsten.

Process Recommendations

Tungsten Grind Angle

Tungsten grind angle is considered a "critical" variable when welding with TOPTIG®. If the angle is too steep or too shallow, it can cause the wire to stub into the base material and push the welding head away from the joint. A grind angle of 60º is recommended when welding with TOPTIG®.

Gas Flow Rate

The gas flow rate is another "critical" variable to consider when welding with TOPTIG®. If the flow rate is too low, not only will it not protect the weld puddle and tungsten properly but it will cause wire stubbing that causes the torch to push away from the joint. If wire stubbing is an issue flow rate should be increased to help alleviate the issue. It is important to note that the nozzles restrict gas flow out of the end of the torch differently depending on the size used, therefore it is very important to verify flow rate at the gas nozzle to insure proper shielding is present. For Steel and Aluminum a flow rate of 40 CFH (19 l/min) is recommended for most applications. For stainless steel a flow rate of 60 CFH (28 l/min) is recommend for most applications. These recommendations are for the 3/8 in. (10 mm) and 1/2 in. (13 mm) gas nozzles.

Tungsten to Wire Spacing

Tungsten to wire spacing is a "critical" variable when welding with TOPTIG®. If the wire is too close it has the potential to contact the tungsten causing it to become contaminated and unusable. If the wire is too far away from the tungsten, it can feed in outside of the weld pool and cause wire stubbing.

Insulating Liner for Torch

It is important that only a Teflon® or plastic liner be used for this. If a metal liner is used in place of the recommended material the nozzle will no longer be isolated and may lead to the nozzle arcing to the work piece. Once the nozzle arcs to the work piece it will no longer be usable and will need to be replaced.

Reel Stand Location and Liner Length

The reel stand should be placed as close as possible to the end on the robot it to keep the liner as short as possible. The liner should not exceed 15 ft. (4.6 m) in length to ensure that proper feeding from the torch.

Wire Stubbing

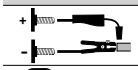
Wire stubbing is an issue that can occur while welding with the TOPTIG® process. It can be caused by feeding more wire than can be melted into the puddle or by the wire being fed outside of the weld puddle. Both of these can cause the head to bounce and result in inconsistent bead profiles. This problem can be remedied by reducing the amount of wire that is being fed into the puddle or by increasing the tungsten stick out to reduce the tungsten to wire distance. Care should be taken to insure that the tungsten to wire distance does not get too small as variations in the wire cast may cause it to touch the tungsten.

14 ga. LAP – Aluminum

Joint Type	Lap
Position	Horizontal
Mode	378
Thickness	14 ga.
Wire Placement	Front

Nozzle Size	3/8 in. (10 mm)	
Water Cooled Nozzle	Yes	
Tungsten Type	EWG (E3)	
Tungsten Diameter	1/8 in. (3.2 mm)	
Tungsten Grind Angle	40°	

EQUIPMENT SETUP

	AC	
	ER4043	
Wire Diameter	in.	1/16
	mm	1.6
	100% Argon	
Flowrate	CFH	40
	l/min	19
	in.	0.125
	mm	3.2
	in.	1.25
	mm	31.8
	in.	7/32
	mm	5.6
	in.	3/32
	mm	2.4

WELD SETTINGS

	Sec.	5.0
Hot Start		0.00
DC Offset		0.00
A_{peak}	Amps	220
A_{base}	Amps	50
	IPM	110
	m/min	2.8
	IPM	-6.0
	m/min	-0.2
	IPM	7.0
	m/min	18
	°	0
	°	60
	Sec	12

LOW FREQUENCY PULSE

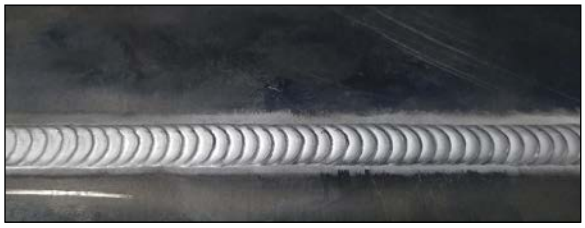
Pulse Frequency	Hz	1.2
Pulse Duty Cycle	%	30

AC SETTINGS

Balance	%	80
Frequency	Hz	200

START SETTINGS

A_{start}	Amps	180
Wait Time	Sec.	1.0
Delay	Sec.	1.5



14 ga. FILLET – Aluminum

Joint Type	Fillet
Position	Horizontal
Mode	378
Thickness	14 ga.
Wire Placement	Front

Nozzle Size	3/8 in. (10 mm)
Water Cooled Nozzle	Yes
Tungsten Type	EWG (E3)
Tungsten Diameter	1/8 in. (3.2 mm)
Tungsten Grind Angle	40°

EQUIPMENT SETUP

	AC	
	ER4043	
Wire Diameter	in.	1/16
	mm	1.6
	100% Argon	
Flowrate	CFH	40
	l/min	19
	in.	0.125
	mm	3.2
	in.	1.25
	mm	31.8
	in.	0.25
	mm	6.4
	in.	1/16
	mm	1.6

LOW FREQUENCY PULSE

Pulse Frequency	Hz	1.0
Pulse Duty Cycle	%	30

AC SETTINGS

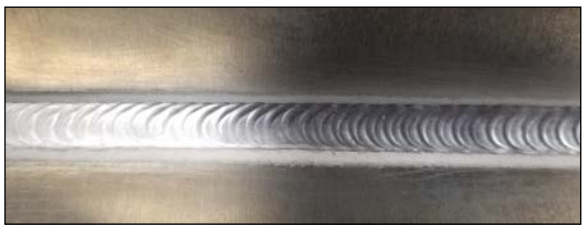
Balance	%	75
Frequency	Hz	110

WELD SETTINGS

	Sec.	5.0
Hot Start		0.00
DC Offset		0.00
A_{peak}	Amps	185
A_{base}	Amps	75
 peak	IPM	155
	m/min	3.9
 base	IPM	-12.0
	m/min	-0.3
	IPM	6.0
	m/min	15
	°	0
	°	42
	Sec	12

START SETTINGS

A_{start}	Amps	150
Wait Time	Sec.	3.0
Delay	Sec.	1.0



0.125 in. LAP – Aluminum

Joint Type	Lap
Position	Horizontal
Mode	378
Thickness	0.125 in. (3.2 mm)
Wire Placement	Front

Nozzle Size	3/8 in. (10 mm)
Water Cooled Nozzle	Yes
Tungsten Type	EWG (E3)
Tungsten Diameter	1/8 in. (3.2 mm)
Tungsten Grind Angle	40°

EQUIPMENT SETUP

	AC	
	ER4043	
Wire Diameter	in.	1/16
	mm	1.6
	100% Argon	
Flowrate	CFH	40
	l/min	19
	in.	0.125
	mm	3.2
	in.	0.125
	mm	3.2
	in.	0.25
	mm	6.4
	in.	5/64
	mm	2.0

LOW FREQUENCY PULSE

Pulse Frequency	Hz	1.2
Pulse Duty Cycle	%	20

AC SETTINGS

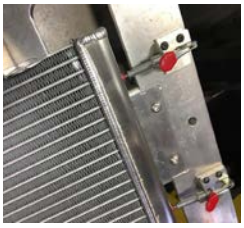
Balance	%	80
Frequency	Hz	200

WELD SETTINGS

t	Sec.	5.0
Hot Start		0.00
DC Offset		0.00
A_{peak}	Amps	250
A_{base}	Amps	130
peak	IPM	140
	m/min	3.6
base	IPM	-12.0
	m/min	-0.3
	IPM	6.5
	m/min	16.5
	°	0
	°	60
t	Sec	12

START SETTINGS

A_{start}	Amps	250
Wait Time	Sec.	4
Delay	Sec.	2

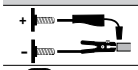


0.125 in. FILLET – Aluminum

Joint Type	Fillet
Position	Horizontal
Mode	378
Thickness	0.125 in. (3.2 mm)
Wire Placement	Front

Nozzle Size	3/8 in. (10 mm)	
Water Cooled Nozzle	Yes	
Tungsten Type	EWG (E3)	
Tungsten Diameter	1/8 in. (3.2 mm)	
Tungsten Grind Angle	40°	

EQUIPMENT SETUP

	AC	
	ER4043	
Wire Diameter	in.	1/16
	mm	1.6
	100% Argon	
Flowrate	CFH	40
	l/min	19
	in.	0.125
	mm	3.2
	in.	0.125
	mm	3.2
	in.	5/16
	mm	7.9
	in.	5/64
	mm	2.0

WELD SETTINGS

	Sec.	5.0
Hot Start		0.00
DC Offset		0.00
A_{peak}	Amps	275
A_{base}	Amps	130
 peak	IPM	165
	m/min	4.2
 base	IPM	-12.0
	m/min	-0.3
	IPM	5.5
	m/min	14.0
	°	0
	°	42
	Sec	12

LOW FREQUENCY PULSE

Pulse Frequency	Hz	1.2
Pulse Duty Cycle	%	25

START SETTINGS

A_{start}	Amps	250
Wait Time	Sec.	2.5
Delay	Sec.	2.0

AC SETTINGS

Balance	%	80
Frequency	Hz	100

0.1875 in. LAP – Aluminum

Joint Type	Lap
Position	Horizontal
Mode	378
Thickness	3/16 in. (4.8 mm)
Wire Placement	Front

Nozzle Size	3/8 in. (10 mm)	
Water Cooled Nozzle	Yes	
Tungsten Type	EWG (E3)	
Tungsten Diameter	5/32 in. (4.0 mm)	
Tungsten Grind Angle	40°	

EQUIPMENT SETUP

	AC	
	ER4043	
Wire Diameter	in.	1/16
	mm	1.6
	100% Argon	
Flowrate	CFH	40
	l/min	19
	in.	3/16
	mm	4.8
	in.	1/8
	mm	3.2
	in.	1/4
	mm	6.4
	in.	3/32
	mm	2.4

LOW FREQUENCY PULSE

Pulse Frequency	Hz	1.0
Pulse Duty Cycle	%	30

AC SETTINGS

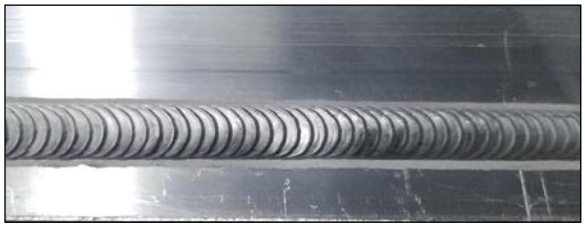
Balance	%	75
Frequency	Hz	200

WELD SETTINGS

	Sec.	5.0
Hot Start		0.00
DC Offset		0.00
A_{peak}	Amps	350
A_{base}	Amps	170
peak	IPM	185
	m/min	4.7
base	IPM	-12.0
	m/min	-0.3
	IPM	6.0
	m/min	15.2
	°	0
	°	60
	Sec	30

START SETTINGS

A_{start}	Amps	325
Wait Time	Sec.	3.0
Delay	Sec.	1.0



0.1875 in. FILLET – Aluminum

Joint Type	Fillet
Position	Horizontal
Mode	378
Thickness	3/16 in. (4.8 mm)
Wire Placement	Front

Nozzle Size		3/8 in. (10 mm)
Water Cooled Nozzle		Yes
Tungsten Type		EWG (E3)
Tungsten Diameter		5/32 in. (4.0 mm)
Tungsten Grind Angle		20°

EQUIPMENT SETUP

		AC
		ER4043
Wire Diameter	in.	1/16
	mm	1.6
		100% Argon
Flowrate	CFH	40
	l/min	19
	in.	3/16
	mm	4.8
	in.	1/8
	mm	3.2
	in.	1/4
	mm	6.4
	in.	3/32
	mm	2.4

LOW FREQUENCY PULSE

Pulse Frequency	Hz	0.8
Pulse Duty Cycle	%	40

AC SETTINGS

Balance	%	80
Frequency	Hz	200

WELD SETTINGS

	Sec.	5.0
Hot Start		0.00
DC Offset		0.00
A_{peak}	Amps	280
A_{base}	Amps	240
peak	IPM	190
	m/min	4.8
base	IPM	-16.0
	m/min	-0.4
	IPM	6.0
	m/min	15
	°	5 (Drag)
	°	42
	Sec	30

START SETTINGS

A_{start}	Amps	350
Wait Time	Sec.	3.0
Delay	Sec.	1.0

16 ga. LAP – Steel

Joint Type	Lap
Position	Horizontal
Mode	375
Thickness	16 ga.
Wire Placement	Front

Nozzle Size	3/8 in. (10 mm)
Water Cooled Nozzle	Yes
Tungsten Type	EWG (E3)
Tungsten Diameter	3/32 in. (2.4 mm)
Tungsten Grind Angle	60°

EQUIPMENT SETUP

	DC-	
	ER70S-2	
Wire Diameter	in.	0.045
	mm	1.1
	100% Argon	
Flowrate	CFH	40
	l/min	19
	in.	1/16
	mm	1.6
	in.	0
	mm	1.6
	in.	3/8
	mm	9.5
	in.	1/16
	mm	1.6

LOW FREQUENCY PULSE

Pulse Frequency	Hz	3.0
Pulse Duty Cycle	%	50

AC SETTINGS

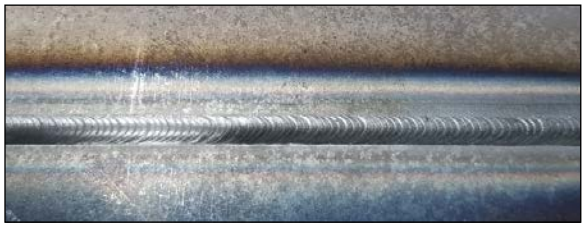
Balance	%	
Frequency	Hz	

WELD SETTINGS

	Sec.	5.0
Hot Start		0.00
DC Offset		0.00
A_{peak}	Amps	115
A_{base}	Amps	65
 peak	IPM	35
	m/min	0.9
 base	IPM	-1.0
	m/min	0.0
	IPM	8.0
	m/min	20
	°	15
	°	25
	Sec	12

START SETTINGS

A_{start}	Amps	120
Wait Time	Sec.	0.5
Delay	Sec.	0.5



16 ga. FILLET – Steel

Joint Type	Fillet
Position	Horizontal
Mode	375
Thickness	16 ga.
Wire Placement	Front

Nozzle Size	3/8 in. (10 mm)	
Water Cooled Nozzle	Yes	
Tungsten Type	EWG (E3)	
Tungsten Diameter	3/32 in. (2.4 mm)	
Tungsten Grind Angle	60°	

EQUIPMENT SETUP

	DC-	
	ER70S-2	
Wire Diameter	in.	0.045
	mm	1.1
	100% Argon	
Flowrate	CFH	40
	l/min	19
	in.	1/16
	mm	1.6
	in.	0
	mm	1.6
	in.	13/32
	mm	10.3
	in.	0.052
	mm	1.3

LOW FREQUENCY PULSE

Pulse Frequency	Hz	1.0
Pulse Duty Cycle	%	50

AC SETTINGS

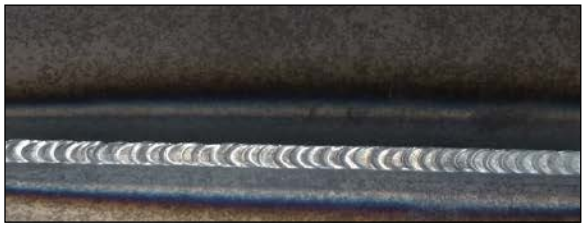
Balance	%	
Frequency	Hz	

WELD SETTINGS

	Sec.	5.0
Hot Start		0.00
DC Offset		0.00
A_{peak}	Amps	120
A_{base}	Amps	60
 peak	IPM	55
	m/min	1.4
 base	IPM	-6.0
	m/min	-0.2
	IPM	6.0
	m/min	15
	°	10
	°	45
	Sec	12

START SETTINGS

A_{start}	Amps	115
Wait Time	Sec.	0.5
Delay	Sec.	0.5



0.125 in. LAP – Steel

Joint Type	Lap
Position	Horizontal
Mode	375
Thickness	0.125 in. (3.2 mm)
Wire Placement	Front

Nozzle Size	3/8 in. (10 mm)	
Water Cooled Nozzle	Yes	
Tungsten Type	EWG (E3)	
Tungsten Diameter	1/8 in. (3.2 mm)	
Tungsten Grind Angle	60°	

EQUIPMENT SETUP

	DC-	
	ER70S-2	
Wire Diameter	in.	0.045
	mm	1.1
	100% Argon	
Flowrate	CFH	40
	l/min	19
	in.	1/8
	mm	3.2
	in.	1/8
	mm	3.2
	in.	1/4
	mm	6.4
	in.	3/32
	mm	2.4

WELD SETTINGS

	Sec.	5.0
Hot Start		0.00
DC Offset		0.00
A_{peak}	Amps	225
A_{base}	Amps	155
	IPM	90
	m/min	2.3
	IPM	-1.0
	m/min	-0.03
	IPM	10.0
	m/min	25
	°	15
	°	25
	Sec	12

LOW FREQUENCY PULSE

Pulse Frequency	Hz	2.5
Pulse Duty Cycle	%	50

START SETTINGS

A_{start}	Amps	150
Wait Time	Sec.	1.0
Delay	Sec.	0.5

AC SETTINGS

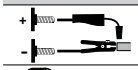
Balance	%	
Frequency	Hz	

0.125 in. FILLET – Steel

Joint Type	Fillet
Position	Horizontal
Mode	375
Thickness	0.125 in. (3.2 mm)
Wire Placement	Front

Nozzle Size	3/8 in. (10 mm)	
Water Cooled Nozzle	Yes	
Tungsten Type	EWG (E3)	
Tungsten Diameter	1/8 in. (3.2 mm)	
Tungsten Grind Angle	60°	

EQUIPMENT SETUP

	DC-	
	ER70S-2	
Wire Diameter	in.	0.045
	mm	1.1
	100% Argon	
Flowrate	CFH	40
	l/min	19
	in.	1/8
	mm	3.2
	in.	1/8
	mm	3.2
	in.	1/4
	mm	6.4
	in.	3/32
	mm	2.4

WELD SETTINGS

	Sec.	5.0
Hot Start		0.00
DC Offset		0.00
A_{peak}	Amps	225
A_{base}	Amps	150
 peak	IPM	90
	m/min	2.3
 base	IPM	-1.0
	m/min	-0.03
	IPM	7.0
	m/min	18
	°	40
	°	20
	Sec	12

LOW FREQUENCY PULSE

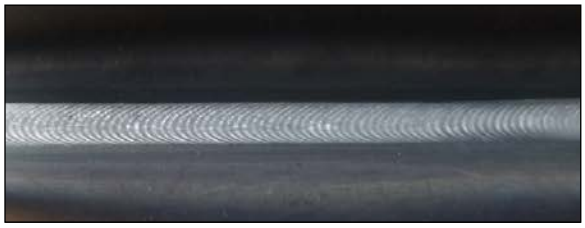
Pulse Frequency	Hz	3.0
Pulse Duty Cycle	%	50

START SETTINGS

A_{start}	Amps	150
Wait Time	Sec.	1.0
Delay	Sec.	0.5

AC SETTINGS

Balance	%	
Frequency	Hz	

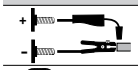


0.1875 in. LAP – Steel

Joint Type	Lap
Position	Horizontal
Mode	375
Thickness	3/16 in. (4.8 mm)
Wire Placement	Front

Nozzle Size	3/8 in. (10 mm)	
Water Cooled Nozzle	Yes	
Tungsten Type	EWG (E3)	
Tungsten Diameter	1/8 in. (3.2 mm)	
Tungsten Grind Angle	60°	

EQUIPMENT SETUP

	DC-	
	ER70S-2	
Wire Diameter	in.	0.045
	mm	1.1
	100% Argon	
Flowrate	CFH	40
	l/min	19
	in.	3/16
	mm	4.8
	in.	1/8
	mm	3.2
	in.	5/16
	mm	7.9
	in.	5/64
	mm	2.0

WELD SETTINGS

	Sec.	5.0
Hot Start		0.00
DC Offset		0.00
A_{peak}	Amps	225
A_{base}	Amps	185
 peak	IPM	106
	m/min	2.7
 base	IPM	-1.0
	m/min	-0.03
	IPM	6.0
	m/min	15
	°	18
	°	26
	Sec	12

LOW FREQUENCY PULSE

Pulse Frequency	Hz	1.5
Pulse Duty Cycle	%	45

START SETTINGS

A_{start}	Amps	280
Wait Time	Sec.	1.0
Delay	Sec.	0.5

AC SETTINGS

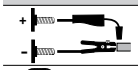
Balance	%	
Frequency	Hz	

0.1875 in. Fillet – Steel

Joint Type	Fillet
Position	Horizontal
Mode	375
Thickness	3/16 in. (4.8 mm)
Wire Placement	Front

Nozzle Size	3/8 in. (10 mm)
Water Cooled Nozzle	Yes
Tungsten Type	EWG (E3)
Tungsten Diameter	1/8 in. (3.2 mm)
Tungsten Grind Angle	60°

EQUIPMENT SETUP

	DC-	
	ER70S-2	
Wire Diameter	in.	0.045
	mm	1.1
	100% Argon	
Flowrate	CFH	40
	l/min	19
	in.	3/16
	mm	4.8
	in.	1/8
	mm	3.2
	in.	5/16
	mm	7.9
	in.	5/64
	mm	2.0

WELD SETTINGS

	Sec.	5.0
Hot Start		0.00
DC Offset		0.00
A_{peak}	Amps	285
A_{base}	Amps	175
 peak	IPM	115
	m/min	2.9
 base	IPM	-1.0
	m/min	-0.03
	IPM	6.0
	m/min	15
	°	10
	°	40
	Sec	12

LOW FREQUENCY PULSE

Pulse Frequency	Hz	1.5
Pulse Duty Cycle	%	60

START SETTINGS

A_{start}	Amps	285
Wait Time	Sec.	1.0
Delay	Sec.	0.5

AC SETTINGS

Balance	%	
Frequency	Hz	

16 ga. LAP – Stainless

Joint Type	Lap
Position	Horizontal
Mode	375
Thickness	16 ga.
Wire Placement	Front

Nozzle Size	3/8 in. (10 mm)
Water Cooled Nozzle	Yes
Tungsten Type	EWG (E3)
Tungsten Diameter	3/32 in. (2.4 mm)
Tungsten Grind Angle	60°

EQUIPMENT SETUP

	DC-	
	ER308L	
Wire Diameter	in.	0.035
	mm	0.9
	100% Argon	
Flowrate	CFH	60
	l/min	28
	in.	1/16
	mm	1.6
	in.	0
	mm	1.6
	in.	3/8
	mm	9.5
	in.	1/16
	mm	1.6

WELD SETTINGS

	Sec.	5.0
Hot Start		0.00
DC Offset		0.00
A_{peak}	Amps	90
A_{base}	Amps	50
peak	IPM	40
	m/min	1.0
base	IPM	-1.0
	m/min	-0.03
	IPM	8.0
	m/min	20
	°	15
	°	25
	Sec	20

LOW FREQUENCY PULSE

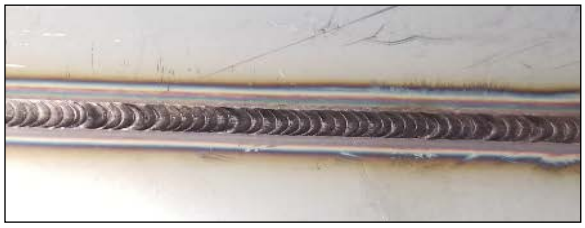
Pulse Frequency	Hz	2.5
Pulse Duty Cycle	%	50

AC SETTINGS

Balance	%	
Frequency	Hz	

START SETTINGS

A_{start}	Amps	80
Wait Time	Sec.	0.5
Delay	Sec.	0.5

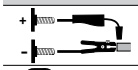


16 ga. FILLET – Stainless

Joint Type	Fillet
Position	Horizontal
Mode	375
Thickness	16 ga.
Wire Placement	Front

Nozzle Size	3/8 in. (10 mm)	
Water Cooled Nozzle	Yes	
Tungsten Type	EWG (E3)	
Tungsten Diameter	3/32 in. (2.4 mm)	
Tungsten Grind Angle	60°	

EQUIPMENT SETUP

	DC-	
	ER308L	
Wire Diameter	in.	0.035
	mm	0.9
	100% Argon	
Flowrate	CFH	60
	l/min	28
	in.	1/16
	mm	1.6
	in.	0
	mm	1.6
	in.	3/8
	mm	9.5
	in.	1/16
	mm	1.6

WELD SETTINGS

	Sec.	5.0
Hot Start		0.00
DC Offset		0.00
A_{peak}	Amps	110
A_{base}	Amps	60
 peak	IPM	53
	m/min	1.3
 base	IPM	-1.0
	m/min	-0.03
	IPM	8.0
	m/min	20
	°	15
	°	45
	Sec	20

LOW FREQUENCY PULSE

Pulse Frequency	Hz	2.5
Pulse Duty Cycle	%	55

START SETTINGS

A_{start}	Amps	80
Wait Time	Sec.	0.5
Delay	Sec.	0.5

AC SETTINGS

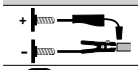
Balance	%	
Frequency	Hz	

0.125 in. LAP – Stainless

Joint Type	Lap
Position	Horizontal
Mode	375
Thickness	0.125 in. (3.2 mm)
Wire Placement	Front

Nozzle Size	3/8 in. (10 mm)
Water Cooled Nozzle	Yes
Tungsten Type	EWG (E3)
Tungsten Diameter	3/32 in. (2.4 mm)
Tungsten Grind Angle	60°

EQUIPMENT SETUP

	DC-	
	ER308L	
Wire Diameter	in.	0.045
	mm	1.1
	100% Argon	
Flowrate	CFH	60
	l/min	28
	in.	1/8
	mm	3.2
	in.	1/8
	mm	3.2
	in.	1/4
	mm	6.4
	in.	3/32
	mm	2.4

WELD SETTINGS

	Sec.	5.0
Hot Start		0.00
DC Offset		0.00
A_{peak}	Amps	175
A_{base}	Amps	120
 peak	IPM	90
	m/min	2.3
 base	IPM	-1.0
	m/min	-0.03
	IPM	7.0
	m/min	18
	°	15
	°	25
	Sec	20

LOW FREQUENCY PULSE

Pulse Frequency	Hz	2.5
Pulse Duty Cycle	%	50

START SETTINGS

A_{start}	Amps	200
Wait Time	Sec.	0.5
Delay	Sec.	0.5

AC SETTINGS

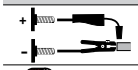
Balance	%	
Frequency	Hz	

0.125 in. FILLET – Stainless

Joint Type	Fillet
Position	Horizontal
Mode	375
Thickness	0.125 in. (3.2 mm)
Wire Placement	Front

Nozzle Size	3/8 in. (10 mm)
Water Cooled Nozzle	Yes
Tungsten Type	EWG (E3)
Tungsten Diameter	3/32 in. (2.4 mm)
Tungsten Grind Angle	60°

EQUIPMENT SETUP

	DC-	
	ER308L	
Wire Diameter	in.	0.045
	mm	1.1
	100% Argon	
Flowrate	CFH	60
	l/min	28
	in.	1/8
	mm	3.2
	in.	1/8
	mm	3.2
	in.	1/4
	mm	6.4
	in.	3/32
	mm	2.4

LOW FREQUENCY PULSE

Pulse Frequency	Hz	3.0
Pulse Duty Cycle	%	50

AC SETTINGS

Balance	%	
Frequency	Hz	

WELD SETTINGS

	Sec.	5.0
Hot Start		0.00
DC Offset		0.00
A_{peak}	Amps	190
A_{base}	Amps	120
 peak	IPM	100
	m/min	2.5
 base	IPM	-1.0
	m/min	-0.03
	IPM	7.0
	m/min	18
	°	20
	°	42
	Sec	20

START SETTINGS

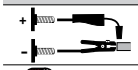
A_{start}	Amps	200
Wait Time	Sec.	0.5
Delay	Sec.	0.5

0.1875 in. LAP – Stainless

Joint Type	Lap
Position	Horizontal
Mode	375
Thickness	3/16 in. (4.8 mm)
Wire Placement	Front

Nozzle Size	3/8 in. (10 mm)
Water Cooled Nozzle	Yes
Tungsten Type	EWG (E3)
Tungsten Diameter	1/8 in. (3.2 mm)
Tungsten Grind Angle	60°

EQUIPMENT SETUP

	DC-	
	ER308L	
Wire Diameter	in.	0.045
	mm	1.1
	100% Argon	
Flowrate	CFH	60
	l/min	28
	in.	3/16
	mm	4.8
	in.	1/8
	mm	3.2
	in.	1/4
	mm	6.4
	in.	3/32
	mm	2.4

WELD SETTINGS

	Sec.	5.0
Hot Start		0.00
DC Offset		0.00
A_{peak}	Amps	175
A_{base}	Amps	145
 peak	IPM	106
	m/min	2.7
 base	IPM	-1.0
	m/min	-0.03
	IPM	6.0
	m/min	15
	°	20
	°	32
	Sec	20

LOW FREQUENCY PULSE

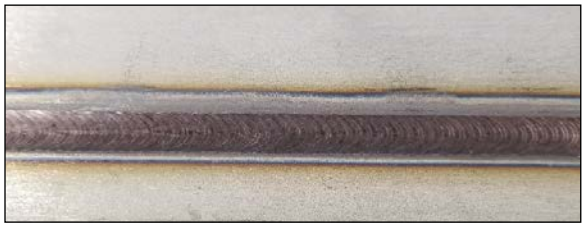
Pulse Frequency	Hz	1.5
Pulse Duty Cycle	%	35

START SETTINGS

A_{start}	Amps	175
Wait Time	Sec.	1.0
Delay	Sec.	0.5

AC SETTINGS

Balance	%	
Frequency	Hz	

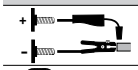


0.1875 in. FILLET – Stainless

Joint Type	Fillet
Position	Horizontal
Mode	375
Thickness	3/16 in. (4.8 mm)
Wire Placement	Front

Nozzle Size	3/8 in. (10 mm)	
Water Cooled Nozzle	Yes	
Tungsten Type	EWG (E3)	
Tungsten Diameter	1/8 in. (3.2 mm)	
Tungsten Grind Angle	60°	

EQUIPMENT SETUP

	DC-	
	ER308L	
Wire Diameter	in.	0.045
	mm	1.1
	100% Argon	
Flowrate	CFH	60
	l/min	28
	in.	3/16
	mm	4.8
	in.	1/8
	mm	3.2
	in.	1/4
	mm	6.4
	in.	3/32
	mm	2.4

WELD SETTINGS

	Sec.	5.0
Hot Start		0.00
DC Offset		0.00
A_{peak}	Amps	220
A_{base}	Amps	137
	IPM	106
	m/min	2.7
	IPM	-1.0
	m/min	-0.03
	IPM	5.0
	m/min	13
	°	20
	°	40
	Sec	20

LOW FREQUENCY PULSE

Pulse Frequency	Hz	1.0
Pulse Duty Cycle	%	60

START SETTINGS

A_{start}	Amps	220
Wait Time	Sec.	1.0
Delay	Sec.	0.5

AC SETTINGS

Balance	%	
Frequency	Hz	

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