

TIG WELDING in MOTORSPORT



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- Lincoln Electric Company Profile
 - Lincoln Electric Motorsport program
- What is TIG Welding ?
 - Why TIG Welding in Motorsport applications
- How to select the Welding Current ? DC or AC ?
 - TIG AC Advanced Features
- TIG Basic Features
 - Lift TIG / HF TIG / Upslope, Downslope / Postflow / Start, Crater /
 - What is TIG Pulse / Why High Speed Pulsing ?
- How to select the right power source ?
- Conclusion & Questions ?



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Company Profile

- Founded in **1895** by John C. Lincoln
- **1895**: Producing first Electric Motors of Lincoln's own design.
- **1911**: Manufacturing the first portable welding machine with variable voltage in the world.



John C. Lincoln

- **2006** : The global Leader in Design, Development and Manufacture of Arc Welding Products, Plasma Cutting, and Robotic Welding Systems

1.8 Billion \$ Worldwide Turnover

Over 7,000 Worldwide Employees

33 Manufacturing Sites in 19 Countries

Representation in over 160 Countries





Lincoln is the industry leader with product offerings, including:

Equipment :

- Stick welders
- TIG welders
- MIG welders
- Plasma cutting
- Engine Driven welders
- Robotic/Automation systems
- Environmental systems



Consumables :

- Mild steel Low alloy steel
- Stainless steels
- Non-ferrous
- Hardfacing applications

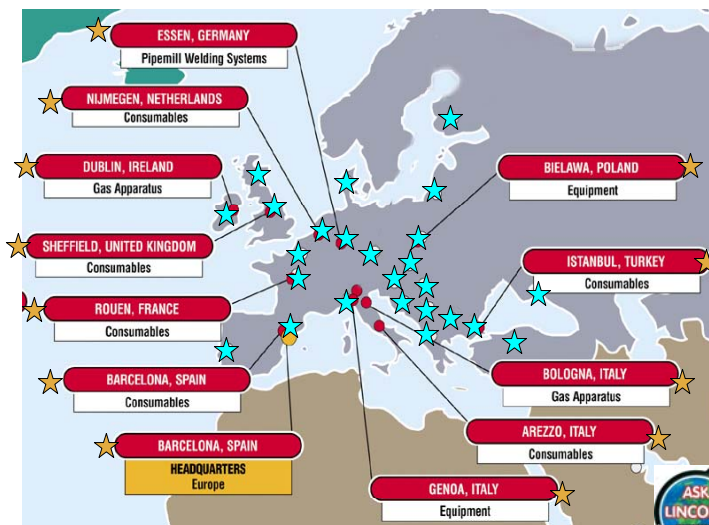


Innovative Technology



Lincoln Electric in Europe

Production and Sales Locations



Motorsports Program

- Enhance Image of Lincoln in Motorsport world
- Drive Technology with car race team
- Create Brand Awareness

- Main elements
 - Safety
 - Performance
 - Ease
 - Accessibility
 - Partnership



Present Involvement in USA

- Officially Licensed Product of NASCAR - 2009
- Contingency Sponsor of NASCAR Busch, Grand National and Weekly Racing Series - 2009
- NASCAR Technical Institute - Curriculum
- NASCAR Research Center Involvement
- Official Welder of the Indy Racing League
- Official Welder of the Infiniti Pro Series
- Official Welder of USAC - 2009
- Official Supplier to ARCA Re/Max Series - 2009
- Series Sponsor ARCA Lincoln Welder Truck Series
- Major Contingency Sponsor of NHRA
- Award presenter for the Toyota Atlantic Series
- Presenting Sponsor of the Valvoline Cup
- Contingency Connection



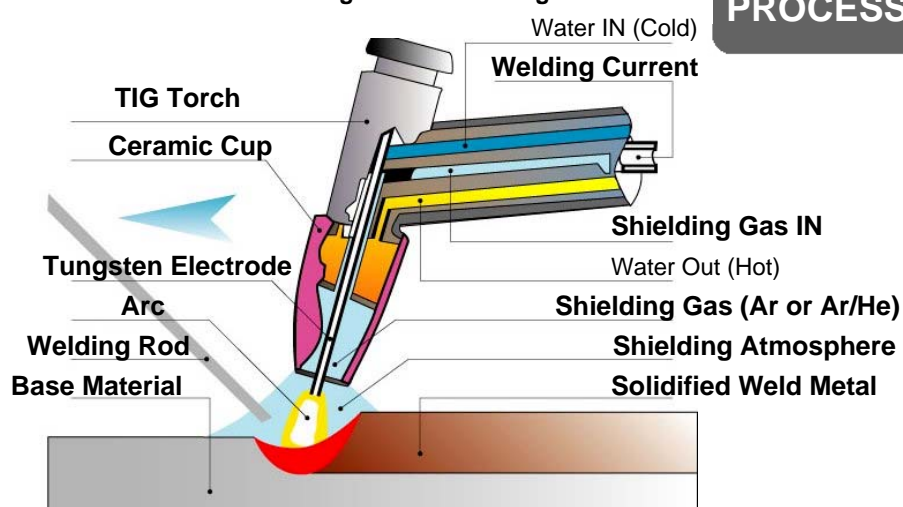
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What is TIG (or GTAW) Welding ?

» Gas Tungsten Arc Welding

GTAW PROCESS



TIG Welding in Motorsport

- Excellent quality of weld with low porosity
- Welds made with or without filler metal
- Precise control of welding variables
- Precise welding on complex piece
- Low amperage to weld on thin materials
- Visually Appealing, no spatters, nice ripples
- Weld all kind of exotic material used in Motorsport (Aluminium, Titanium, Chromolybdenum, magnesium...)
- Ideal process for frequently starts / stops and short welds
- Limitations : Requires greater welder dexterity, low deposition rate, more costly on thick sections

WHY TIG WELDING ?



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How to select the Welding Current ?

Steel
Stainless Steel
Titanium
Copper
Nickel Alloys

Welding Current

DC-

Why DC- ?

High energy level at the welding puddle

Low energy at the tip of the electrode (sharp)

Current type	DC-	
Electrode polarity	Negative	
Penetration characteristics		
Oxide cleaning action	No	
Heat balance in the arc (approx.)	70% at work end 30% at electrode end	
Penetration	Deep; narrow	
Electrode capacity	Excellent e.g. 3.18 mm (1/8 in.) - 400 A	
Electrode type	Thoriated, ceriated, lanthanated	



How to select the Welding Current ?

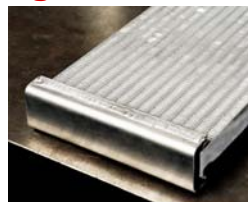
Aluminium
Magnesium

Welding Current

AC

Why AC ?

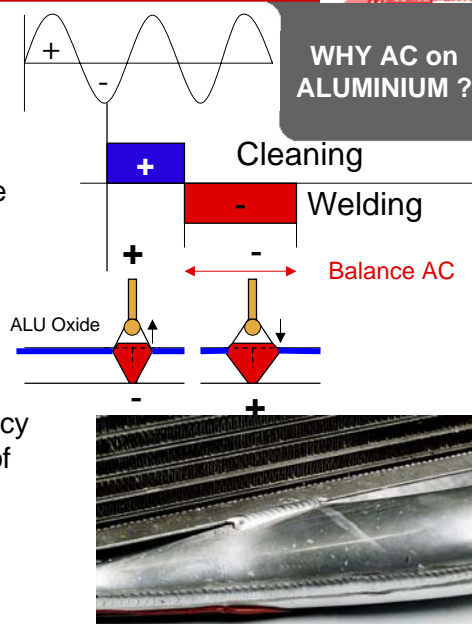
Current type	AC	
Electrode polarity	AC (+ and -)	
Penetration characteristics		
Oxide cleaning action	Yes - Once every half cycle	
Heat balance in the arc (approx.)	50% at work end 50% at electrode end	
Penetration	Medium	
Electrode capacity	Good e.g. 3.18 mm (1/8 in.) - 225 A	
Electrode type	Pure tungsten, ceriated, lanthanated	



- Aluminum has a melting point less than 700°C
- Aluminum oxide on the surface has a melting point above 1800°C
- Reverse polarity, half of the AC arc, breaks and clean the oxide "skin" ahead of the weld

Why AC ?

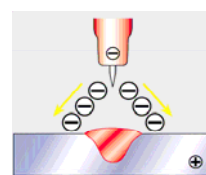
- Typical Sinusoidal changes polarity gradually
- Square Wave changes polarity instantly for smoother and stable arc
- The AC TIG processes is using the positive period for cleaning
- The Negative period is used for welding. (penetration)
- As a result: The process efficiency of AC TIG is low as only a part of the period is used for welding
- **Need to optimize Welding by**
 - **Cleaning before welding**
 - **adjusting Balance AC**



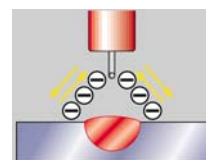
WHY AC on ALUMINIUM ?

TIG AC vs TIG DC-

- The thermal conductivity of Aluminum compared to Stainless is 12 times higher.
- We need more energy for the same volume of Aluminum
- The process efficiency is lower because of the AC wave form
- Conclusion: We need much more energy (Welding Amp's) to weld the same plate thickness.



*Stainless sheet welding:
Most used tungsten 1.6 mm
Setting approx.. 25>30Amps/mm*

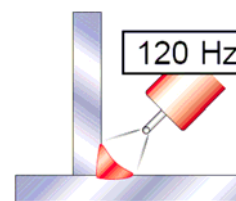
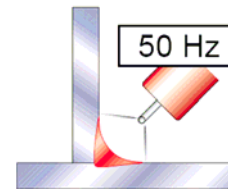


*Aluminum sheet welding:
Most used tungsten 2.4 mm
Setting approx.. 30>40Amps/mm*

AC TIG
Aluminum
versus DC TIG
Stainless

- The Argon TIG arc is spread from itself.
- As a result the energy per surface is low.
- Concentrating the arc on a smaller surface with the same welding current will increase energy per mm²
- Increasing the AC Arc frequency will focus the arc.
- Concentrating the heat on a smaller surface will:
 - Reduce the welding current
 - increase the travel speed
 - reduce the heat input/cm
 - >> less distortion

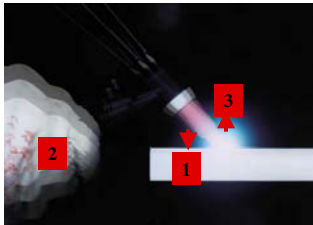
Feature: AC frequency



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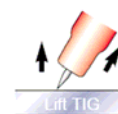
LIFT TIG strike mode



- 1. Bring slowly the TIG torch electrode on the work piece.
- 2. Press the trigger of the TIG torch.
- 3. **Lift** the electrode from the work piece to start the TIG arc.

Basic Features

- Electronic device minimizes short circuit current before starting.
- Electrode wear and tungsten inclusions in the weld pool are considerably reduced compared to Scratch start.
- Used for :
 - Occasional TIG welding
 - TIG Welding when using appliances sensitive to electromagnetic interference like electronic on racing cars.



For excellent TIG welding everywhere, anywhere !

HF TIG strike mode



- 1. Bring slowly the electrode at 2 to 4 mm from the work piece.
- 2. Press the trigger of the TIG torch.
- 3. **High Frequency spark** ignites the arc.

Basic Features

- Advantages :
 - The electrode doesn't touch the piece.
 - No risk of tungsten inclusion in the weld.
 - No wearing of the tungsten electrode tip
- Used for :
 - High metallurgical quality TIG Welding
 - Precision TIG Welding

For outstanding and professional TIG welds

Start Current

Basic Features



- Hot / Soft Start



- Soft Start on Steel and Stainless steel to avoid burn through
- Aluminum is an excellent conductor of heat.
- The welding of aluminum requires Hot start always.

Upslope

Basic Features

After the arc starting sequence, current goes from Start level to welding current value

- Upslope



Weld pool formation is facilitated.

Welding Current

Basic Features

- Weld Current

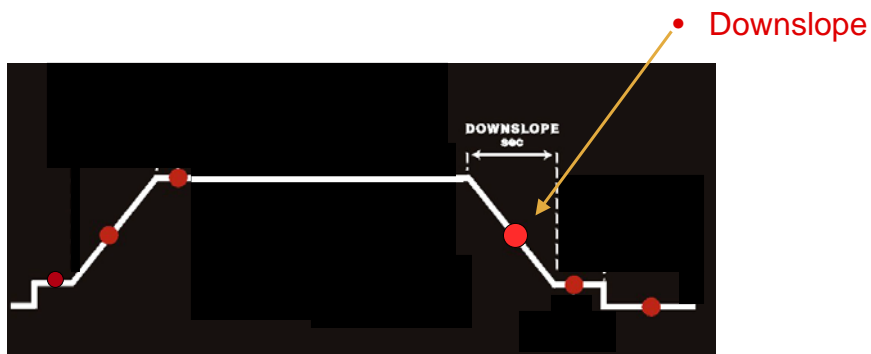


Weld current can be adjusted while welding to control heat input

Downslope

Basic Features

At the end of the weld, the current gradually decreases from Welding value to Crater level



End of welding is optimized

Crater Current

Can be useful in some applications in order to better finish the weld pool and avoid final crater.

Basic Features

Crater Current



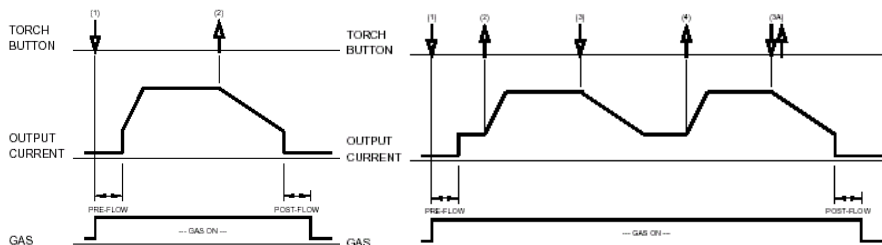
Final Crater is avoided to prevent cracking

Trigger mode :

– 2 steps

– 4 steps

Basic Features



Control the heat input with one push button

Postflow Gas Control This enables the weld pool to cool down under protected atmosphere.

Basic Features



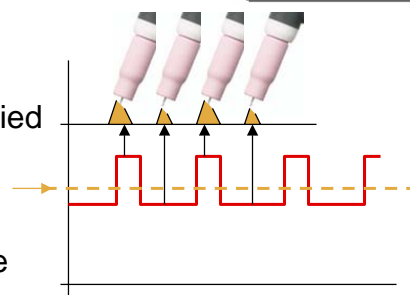
Postflow

It protects the weld pool and tungsten electrode from oxidation

What is TIG PULSE ?

Advanced Features

- The welding current blinks between two set values:
 - Peak current
 - Background current
- The average gives less heat applied to the piece
- It is ideal for welding thin plates.
- It helps the operator to control the welding process and obtain more uniform, precise and attractive weld beads.



Less heat means less distortion !

Pulse parameters :

– Frequency :

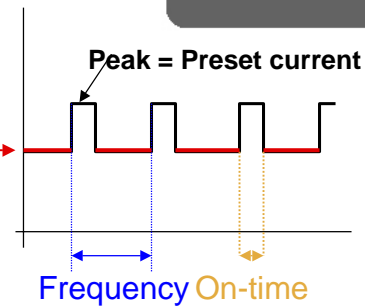
- Normal Pulse welding in a frequency range between 0,2 to 20 Hz.

– Background Current :

- It is the current during the low portion of the pulse waveform.
- It can be adjusted from 10% to 90% of the welding (peak) current.

– On-time Control :

- Adjust the peak pulsing on-time.
- The on-time can be adjusted from 10% to 90% of the pulsing period.

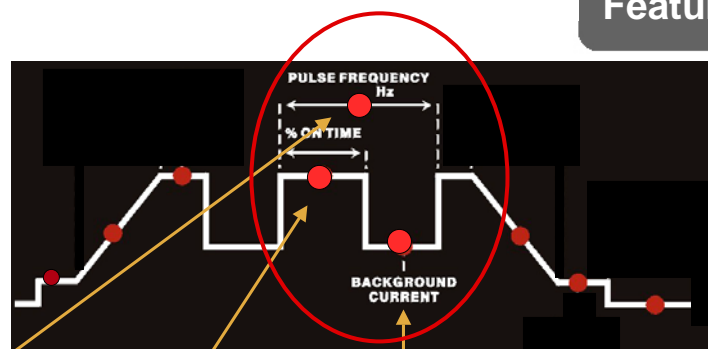


Shape it the way you want it !

Advanced Features

Pulse parameters :

Advanced Features



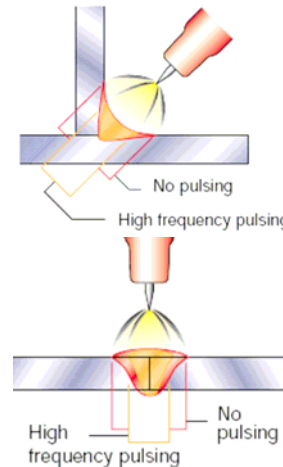
- Pulse Frequency
- Time in
- Background Current

High Speed Pulse

- Pulsing above 100Hz and up to 300-500Hz means **High Speed Pulsing**.
- You can't see the arc blinking any more, however the arc is pulsing.
- The arc is more concentrated (focused).
- The heat altered zone is smaller
- Distortion is decreased.
- Welding speed is higher (compared to normal TIG process).

Focus on energy and speed !

Advanced Features

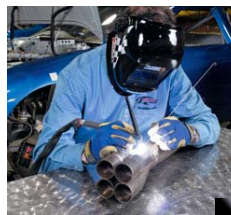


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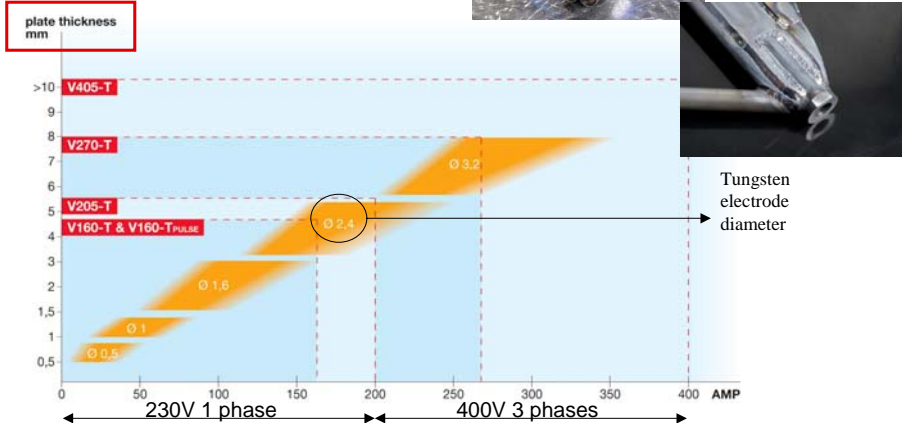
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TIG DC Applications

- To select max Power of the TIG DC machine, Check :
 - Plate Thickness to be welded
 - Input power available on site



Selection Chart

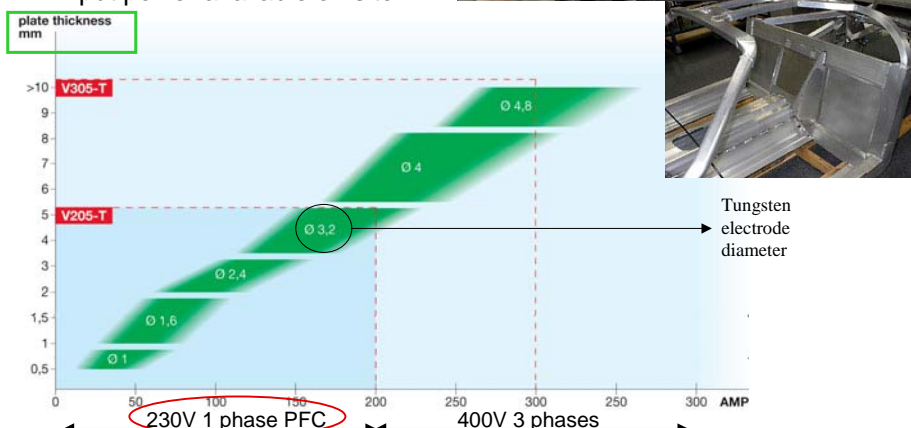


TIG AC Applications

- To select max Power of the TIG AC/DC machine, Check :
 - Plate Thickness to be welded
 - Input power available on site



Selection Chart



How to get max. out of 230V plug ?

- Most of TIG applications are done on site where we have 230V / 1phase available
- The max current available from Power Network at 230V is limited at 16A with a slow blow fuse
- The maximum welding amperage reachable with traditional inverters is max 160A
- Machines welding on Aluminum need a higher amperage & efficiency to perform
- **P**ower **F**actor **C**orrection is the way to maximize the output at 230V 16A and be able to reach 200A welding output

What is PFC ?



V205T
AC/DC
featuring
PFC
Technology

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Conclusion

- Choose TIG welding for high quality welds on all kind of materials
- Use ALternative Current for Aluminium, DC for the rest of materials
 - Clean Aluminium plate and adjust balance to optimise AC welding efficiency
 - Play on AC frequency to focus the arc and minimise distortion
- Recommended Lift TIG striking mode when welding on car frame, and HF for excellent striking
- Play with Higher Hot Start and long up-slope to preheat Aluminium plate, long down-slope & lower crater level to avoid shrinking cracks
- Use Pulse to control the heat input and High Speed Pulse to focus the arc and minimise distortion
- Select the right machine for the right application (material to be welded, max thickness, input power availability)

CONCLUSION & QUESTIONS



QUESTIONS ?