e-Weldone

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ADOR WELDING LIMITED
Formerly **Advani - Oerlikon Ltd.**

PRECISION WELDING BY GTAW OR TIG WELDING

Introduction

GTAW or more frequently called as TIG welding process is a process, which is normally used for good quality and precision welding. It is very neat and clean welding process where localized heat is produced by narrow and concentrated arc. The appearance of bead is uniform with good weld finish. This process is used for welding of steel, copper, aluminium and magnesium material. This welding process is inherently less productive and costlier.

Benefits of TIG welding

- Narrow arc, resulting into concentrated heat
- Less heat affected zone
- No slag formation
- No molten globule therefore no spatter
- No flying spark as there is no transfer of metal in the arc
- No buzzing sound of arc
- Arc is stable, smooth and quiet
- No smoke or fumes
- High quality and low distortion weld
- Process is easy to mechanise and automate
- It can weld all metals

- It can weld thin sheets
- Good looking weld bead

Limitations of process

1. Comparatively lower deposition rates
2. Good skill of welder is required
3. To acquire skill lot of practice is required.
4. Sensitive to cleanliness and contamination

Arc starting

HF start

To ignite the arc we have to superimpose high voltage with high frequency in series with main welding circuit. This voltage produces strong electric field which ionises the argon gas and creates conductive path for current to start. Thoriated tungsten electrode assists in igniting the arc by emitting more free electrons. Once arc is established, main welding current increases to set value. Thus arc is started without touching the electrode to work piece.

In DC TIG welding once the arc is established, HF is cut off and welding is performed. However in AC TIG welding HF superimposition is required continuously.

Touch start or lift arc start

Electrode is touched to work piece and then lifted to initiate the arc.
When electrode is in contact with parent metal, power source reduces the voltage and current. Arc is ignited with lower voltage and current to avoid contamination and burn through. After arc is established, the current increases to set value. This method of arc ignition is used when high voltage is injurious to other circuits of job to be welded and not permitted. (For example welding directly on automobile body)
TIG welding process requires welding equipment with Constant Current (or CC) characteristics and all metals except Aluminum, Magnesium and their alloys can be welded by DC TIG process; Aluminum, Magnesium and their alloys can be welded by AC TIG process.
The relation between Arc voltage (V) and welding current (I) is given by
$V = 10 + 0.04 * I$
Power source with true constant current characteristics gives excellent arc stability and very goon bead shape.

Main components of GTAW process

1. Constant current power source (DC or AC)
2. High frequency unit
3. Torch
4. Shielding gas
5. Water circulation unit for high current welding.
6. Accessories

Power source

There are various types of power sources to meet CC requirement.
DC type:

- Diode type with transductor current control.
- Thyristrrised with phase angle control.
- Inverter type with PWM control.

AC type:

- AC Arc Welders with sine wave.
- Inverter type with square wave AC

Power source provides basic welding power required for heat input. Depending on type of welding (DC or AC TIG), power sources are either DC or AC with CC type voltage and current characteristics. Inverter type power sources are energy efficient and save energy by up to 30% to 35% over diode or thyristor type power sources. Also these energy efficient power sources are light weight and compact. The lower current rating power sources up to 200 amps rating can be single phase machine where as power sources with higher current ratings are three phase machines. The inbuilt or composite TIG welding units have high frequency units built within the power sources.

In DC TIG process, basic power source is either static type such as diode, Thyristor or Inverter based DC rectifiers or rotary type such as motor or engine driven generators. The torch is connected to the –ve terminal of the power source. Heat distribution in DC TIG process is 33% at the electrode and 67 % at the job.

In AC TIG process, welding power source is AC (for example – Transformer or inverter with square wave AC) which provides alternating current and thus polarity of electrode gets reversed. In positive half cycle oxide cleaning action takes place with 67 % heat distribution at the electrode and 33 % at the job. In negative half cycle there is more penetration with 33 % heat distribution at the electrode and 67 % at the job.

High frequency unit

This is available either as separate unit or built inside the power source. If it is separate unit, then this unit has to connect at the output terminals of power source and TIG torch and earth cables should be connected to this unit.
High frequency units basically provide following in a TIG welding outfit

- **High frequency/high voltage supply** which is superimposed on the TIG welding power given from the power source unit
- **Controls for gas pre-flow and post-flow time adjustments**, Automatic HF cutoff , once the arc is struck and automatic HF start if arc breaks, in case of DC TIG welding
- **Providing HF continuously, gas pre-flow and post-flow controls** in case of AC TIG welding
- **Gas pre-flow control helps to remove the air available in the torch, before the arc** strikes, thus ensuring positive shielding of weld even during arc striking. The gas post-flow control helps to ensure the shielding of weld puddle until it gets cooled at the end of welding and thus avoids any weld contamination due to atmospheric oxygen/nitrogen etc. It also help to cool down the tungsten electrode, avoiding oxidation and finally increasing it's life
- **Current upslope and down slope controls**. Upslope control avoids sudden initial current surge and down slope control avoids/minimizes the crater formation at the end of welding

TIG welding torches

TIG welding Torches form an important part of TIG welding outfit. The gas cooled TIG welding torches have (unlike GMAW or MIG torches) a Tungsten electrode which does not get consumed. TIG torches comprise current carrying cable, gas hose (to carry the shielding gas), torch switch, switch cables and torch head which holds the tungsten electrode. Water cooled torches have additionally water circulating arrangements/pipes ,over and above other components mentioned above.

These torches are normally available with 4 mtr and 8 mtr length cables. AWL offers HIPROTIG series of torches for different current capacities

Tungsten Electrodes used for TIG welding process

Tungsten electrode type and size play very important role in arc stability, particularly in

- M/S ONSHORE CONSTRUCTION COMPANY KALAMBOLI – NAVI MUMBAI AREA - 18 Machines
- M/S TEXMACO LTD AGARPARA WORKS KOLKATA - KOLKATA AREA- 72 Machines
- M/S GREEN MARK INFRA LTD. KOLKATA - KOLKATA AREA - 11 Machines
- M/S KOLHAPUR STEELS SHIROLI MIDC KOLHAPUR- PUNE AREA - 03 Machines
- M/S TRIVENI EARTHMOVERS PVT LTD BOMBARI & BARBILSITE- ROURKELA AREA - 25 Machines
- M/S HARI MACHINES LTD. RAJ-GANGPUR ROURKELA – ROUR-KELA AREA - 65 Machines

AC TIG welding. Following types of electrodes are generally used in different applications and requirements

- Pure Tungsten
- Thoriated Tungsten
- Zirconiated Tungsten

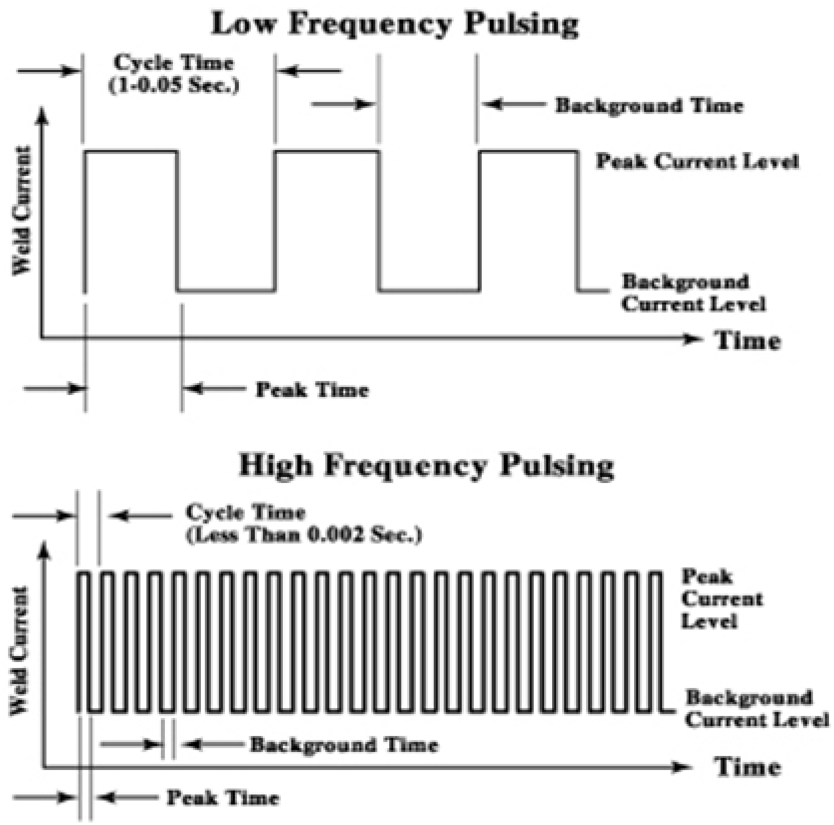
Pure tungsten electrodes are generally used for less critical applications and have relatively lesser current carrying capacity.
Thoriated Tungsten electrodes (1% to 3%) have higher current capacity and give better arc starting and arc stability due to their higher electron emission property. They have generally longer life and greater resistance to contamination.
Zirconiated tungsten electrodes (0.3 to 0.5%) have greater resistance to contamination and retain clean balled tip which is preferable, especially for aluminum welding
Appropriate size of electrode must be used and electrodes must be ground properly to maintain a good welding arc.

Water cooled outfits

TIG welding outfits are provided with water cooling units for the cooling of the torch when TIG welding is used for regular production jobs for the full shift with welding currents more than 150A to 200A. The interlocking is provided in such a way that the power source and thus the TIG welding starts only when the required water pressure and flow is available from the water cooling unit. The TIG torch does not get heated up and the welder can continue the welding quite comfortably without any fatigue which is generally due to overheating of torch.

Pulsed TIG welding

Pulsed TIG welding is normally used when precision TIG welding is to be done, particularly for thin sheet or tube preferably using automation. The problem of excessive heat build up, like joint fit up distortions, widening of weld bead, burn through in extra thin jobs, and bigger HAZ in case of normal TIG welding , can be completely avoided by using pulsed TIG welding process. In pulsed TIG welding heat is applied in a controlled and periodic manner, using pulsing of set welding current.
The aim of pulsing is to achieve maximum penetration without excessive heat build up by allowing high heat during peak current and cooling down the weld pool during background current by maintaining the arc.



Pulse TIG welding offers many advantages when applications call for welding of thin sheets where heat control is required. Pulse TIG controls heat input and reduces distortion of job and improves quality of welding.

Main parameters are

- Peak current
- Peak time
- Background current
- Background time

A power source with pulsing facility will have all controls necessary to fulfill process requirements.

Inverter type DC power source

1. **Gas pre flow and post flow:**
   Starting and stopping the welding operation without pre flow and post flow will

cause instant damage to tungston electrode. Observe tip at start and at the end of welding. If colour is grey or black then pre flow and post flow times are less and gas flow is less.

Gas pre-flow control helps to remove the air available in the torch, before the arc strikes, thus ensuring positive shielding of weld even during arc striking. The gas post-flow control helps to ensure the shielding of weld puddle until it gets cooled at the end of welding and thus avoids any weld contamination due to atmospheric oxygen/nitrogen etc. It also help to cool down the tungsten electrode, avoiding oxidation and finally increasing life of electrode.

2. **Current up slope and down slope:**
   Upslope control avoids sudden initial current surge and down slope control avoids/minimizes the crater formation at the end of welding
3. **Peak current:**
   To control required heat input as per thickness of sheet
4. **Back ground current:**
   It is to be set with proportion to peak current to ensure that arc is maintained and job is also cooled.
5. **Peak time and back ground time:**
   To be decided by sheet thickness and %overlap required for weld bead.

Advantages of Pulsed TIG welding

1. Joint fit up distortions are minimized due to controlled heat input.
2. Better bead shape, penetration is achieved with relatively less skill of welder
3. Heat Affected Zone (HAZ) is reduced.
4. Positional welding is possible without any difficulty of dropping down of molten metal.
5. Process can be automated.

Applications of TIG process

Welding of aluminum, copper, magnesium nickel and their alloys
Welding of mild steel, stainless steel, inconel and titanium
Welding of bellows
Welding of thin sheets
Application in chemical industry, aircraft industry, manufacturing of food cans
Copper tubes
Stainless steel tubes
Nuclear power plant
Welds can be done with or without filler material depending on thickness of material

Ador Welding Ltd. (AWL) range of TIG and Pulse TIG machines are as follows:

Sr No	Parameters	CHAMPTIG 163	CHAMPTIG 300 P	CHAMPTIG 300 AD
1	Process Type	DC TIG / MMA	DC Pulse TIG/ MMA	AC/DC Pulse TIG and MMA
2	Input Power Supply	240Vac , 1 Phase	415 Vac , 3 Phase	415 Vac , 3 Phase
3	Current Range	5-160A	5-300 A	10-300A for DC and 25-300A for AC
4	Duty cycle	Light Duty : 160A @ 25% duty cycle	Heavy Duty : 300A @ 60% duty cycle	Heavy Duty : 300A @ 60% duty cycle
5	Pulse TIG Parameters	Not Applicable		
	Duty ratio	-	10-90 %	10-90 %
	Pulse Frequency	-	0.5 -10 Hz	0.5- 500 Hz
	Base /Background current	-	5 - 90% of I_{pulse} current	10-300A in DC 25-300 A in AC
	Pulse Peak current	-	5 – 300 A	10-300A in DC 25-300 A in AC
6	Start current	Not Available	5 – 300 A	10-90% of Background current
7	Current upslope time	Not Available	0-10 Second	Not Available
8	Current down slope	1-10 second	0 – 10 Second	0.1- 5 Second
9	Pre-Flow	0.1 Second	0-5 Second	0.1 Second
10	Post-Flow	1-10 Second	1-20 Second	2-25 second
11	Crater current	Not Available	5-300 A	10-90% of Background current
12	Arc Ignition	HF start or Lift arc	HF Start or Lift Arc	HF Start
13	Torch	Gas Cooled Torch	Water cooled Torch	Water cooled Torch
14	Water Cooling Unit for Torch	Not Required	Available as standard	Available as Standard

In addition to above TIG outfit with inbuilt HF units, AWL offers separate HF units which can be used along with SMAW Power source. Following combination of models make up TIG outfits of various current ratings.

	Power Source	HF Unit	Rating
	Transformer / DC Power source	HF 2000AD	AC/ DC TIG with 200A
	Transformer / DC Power source	HF 3000AD	AC/DC TIG with 300A
	GL401	HF 3000	300A
	THYROLUXE 401	HF 2000 / HF 3000	200A/ 300A
	THYROLUXE 600	HF 2000 / HF 3000	200A / 300A
	THYROLUXE 400	HF 2000 / HF 3000	200A/ 300A
	CHAMP 250	HF 2000	200A
	CHAMP T400	HF 2000 / HF 3000	200A/300A
	CHAMP 400	HF 2000 / HF 3000	200A/300A
	CHAMP 500	HF 2000 / HF 3000	200A/300A
	CHAMP 600	HF 2000 / HF 3000	200A/300A

For more information, Please write to us cmo@adorians.com or visit www.adorwelding.com

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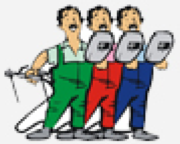
(Formerly known as Advani-Oerlikon Limited)



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