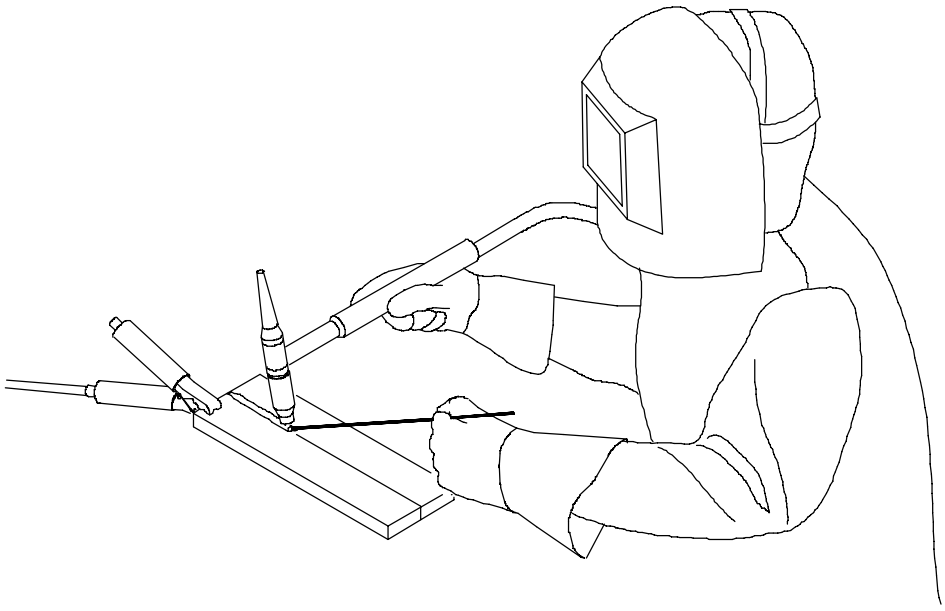

Guidelines To Gas Tungsten Arc Welding (GTAW)

⚠ WARNING **ARC WELDING can be hazardous.**

This document contains general information about the topics discussed herein. This document is not an application manual and does not contain a complete statement of all factors pertaining to those topics.

This installation, operation, and maintenance of arc welding equipment and the employment of procedures described in this document should be conducted only by qualified persons in accordance with applicable codes, safe practices, and manufacturer's instructions.

Always be certain that work areas are clean and safe and that proper ventilation is used. Misuse of equipment, and failure to observe applicable codes and safe practices, can result in serious personal injury and property damage.

Ref. 161892-B

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SECTION 1 − SAFETY

⚠ WARNING

ELECTRIC SHOCK can kill.

- Always wear dry insulating gloves.
- Insulate yourself from work and ground.
- Do not touch live electrical parts.
- Keep all panels and covers securely in place.

FUMES AND GASES can be hazardous to your health.

- Keep your head out of the fumes.
- Ventilate area, or use breathing device.
- Read Material Safety Data Sheets (MSDSs) and manufacturer's instructions for material used.

WELDING can cause fire or explosion.

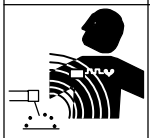
- Do not weld near flammable material.
- Watch for fire; keep extinguisher nearby.
- Do not locate unit over combustible surfaces.
- Do not weld on closed containers.
- Allow work and equipment to cool before handling.

ARC RAYS can burn eyes and skin; NOISE can damage hearing.

- Wear welding helmet with correct shade of filter.
- Wear correct eye, ear, and body protection.

HOT PARTS can cause injury.

- Allow cooling period before touching welded metal.
- Wear protective gloves and clothing.



MAGNETIC FIELDS FROM HIGH CURRENTS can affect pacemaker operation.

- Pacemaker wearers keep away.
- Wearers should consult their doctor before going near arc welding, gouging, or spot welding operations.

FLYING METAL can injure eyes.

- Welding, chipping, wire brushing, and grinding cause sparks and flying metal. As welds cool, they can throw off slag.
- Wear approved safety glasses with side shields even under your welding helmet.

WELDING CURRENT can damage electronic parts in vehicles.

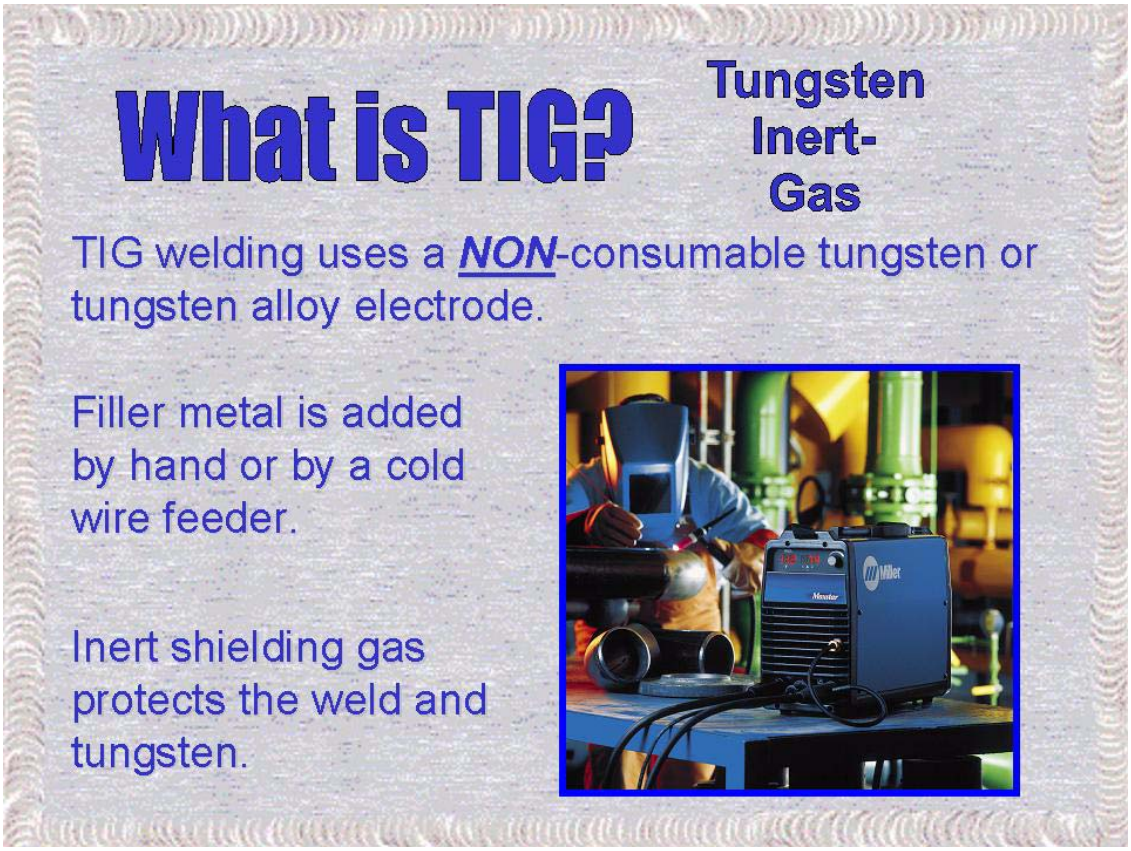
- Disconnect both battery cables before welding on a vehicle.
- Place work clamp as close to the weld as possible.

See Safety Precautions at beginning of welding power source Owner's Manual for basic welding safety information. swarn6.2* 8/92

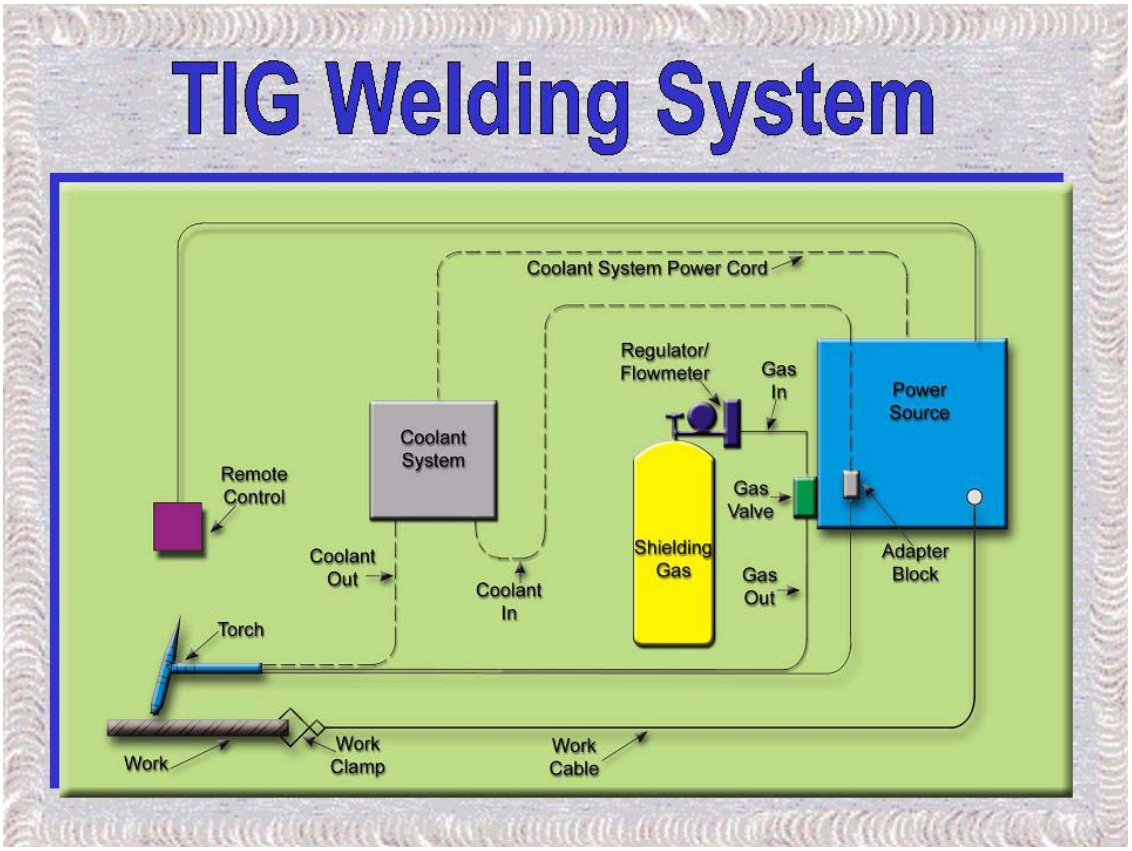
☞ This booklet is a guide to TIG welding basics. More detailed information can be obtained by purchasing the TIG Handbook from MILLER ELECTRIC.

SECTION 2 − THE TIG PROCESS

2-1. What Is TIG



2-2. GTAW (TIG) Connections



2-3. TIG Advantages

TIG Advantages

- High Quality & Precision
- Pin Point Control
- Aesthetic Weld Beads
- No Sparks or Spatter
- No Flux or Slag
- No Smoke or Fumes

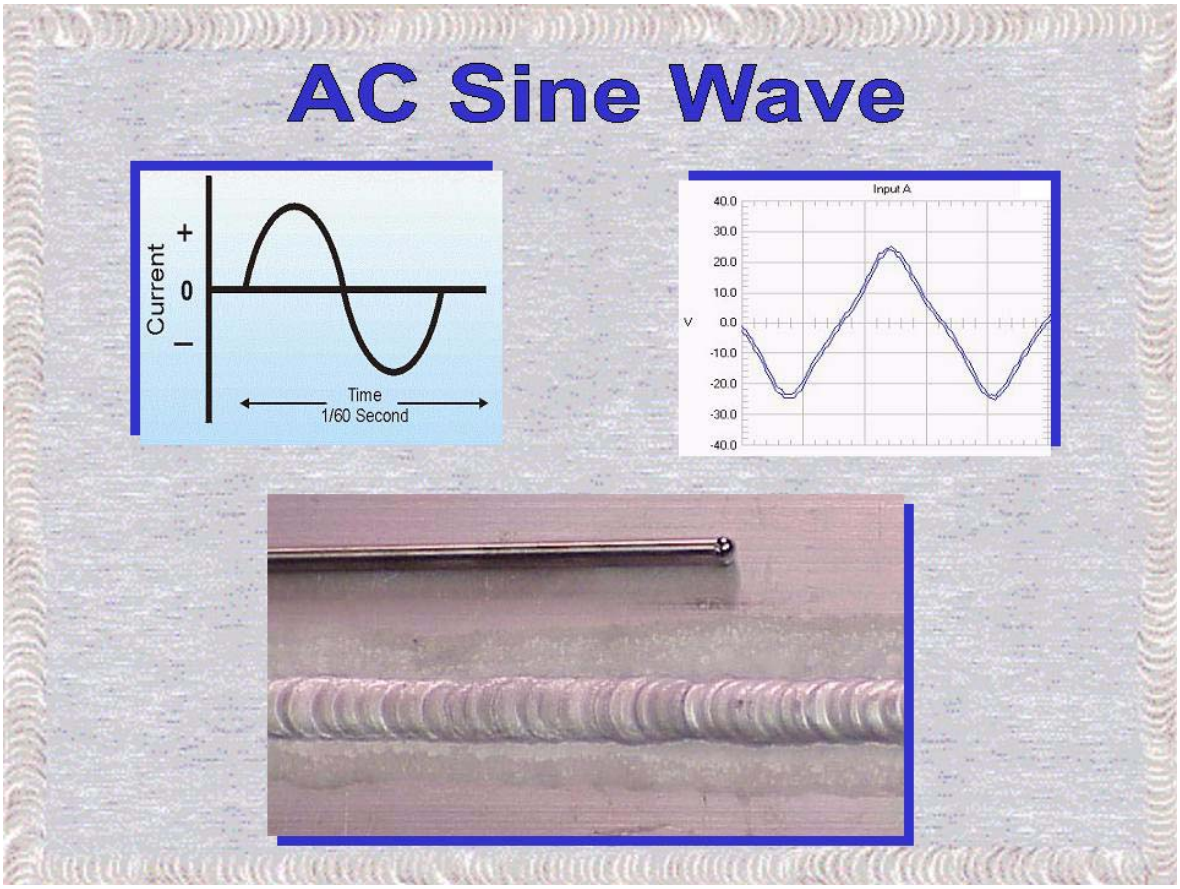
- Welds More Metals and Metal Alloys Than Any Other Process

2-4. TIG Disadvantages

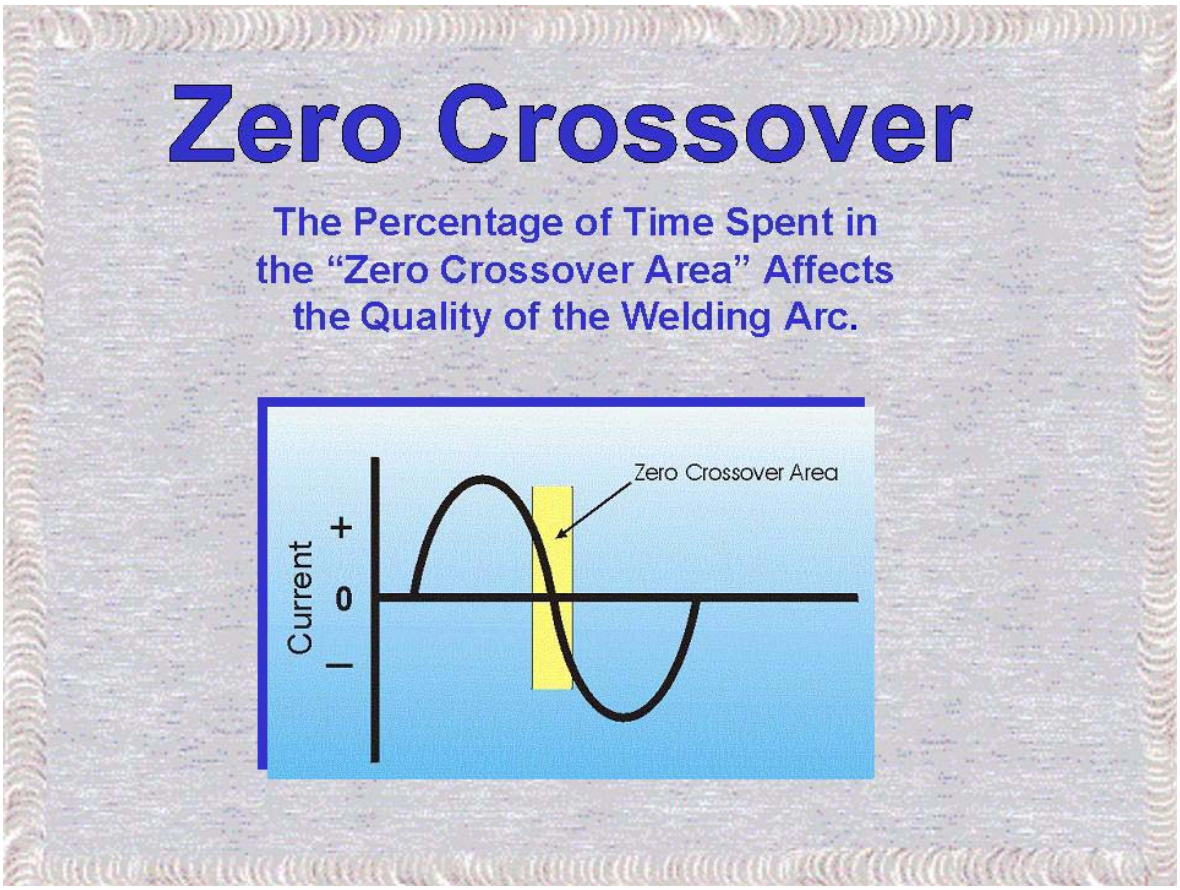
TIG Disadvantages

- Slower Travel Speeds than other Processes
- Lower filler metal deposition rates
- Hand-eye coordination is a required skill
- Brighter UV Rays than other processes
- Equipment costs can be higher than other processes

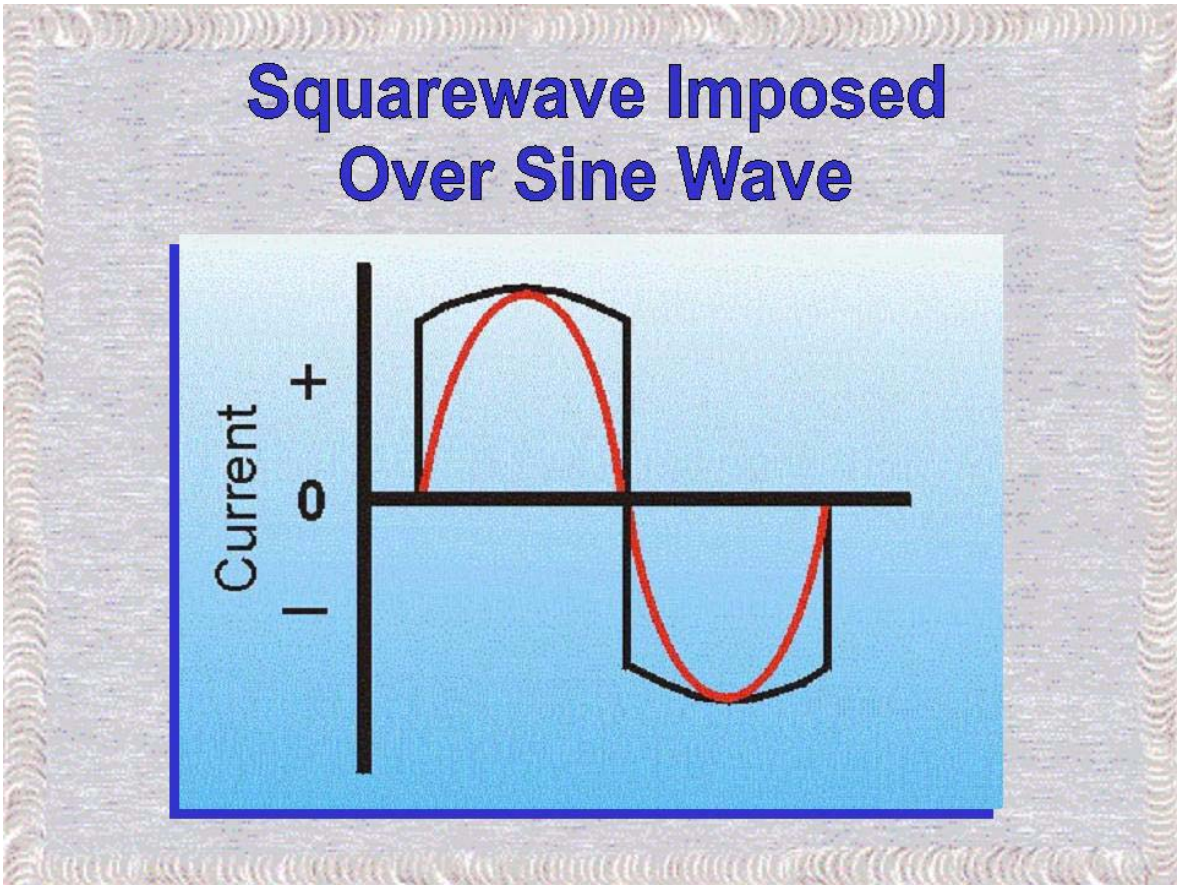
2-5. AC Sine Wave



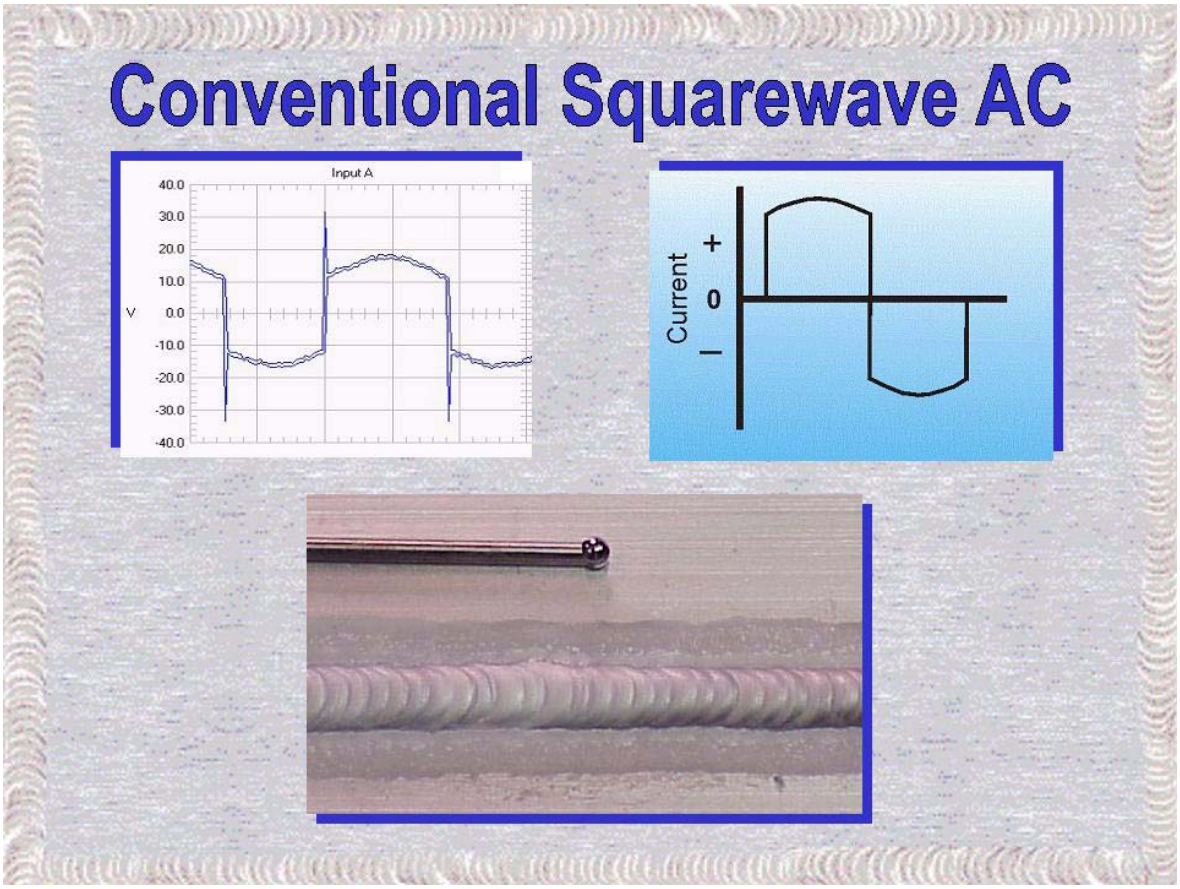
2-6. Zero Crossover Area



2-7. Squarewave Imposed Over A Sinewave

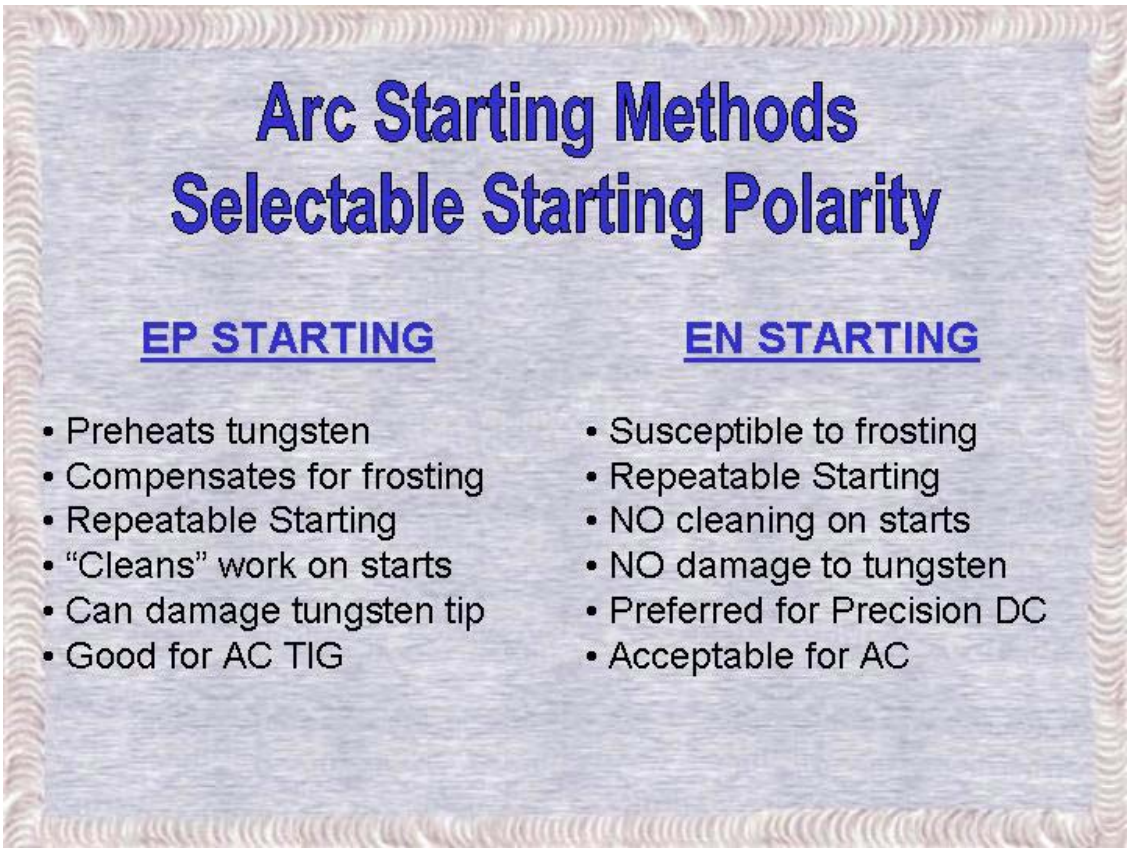


2-8. Conventional Squarewave AC

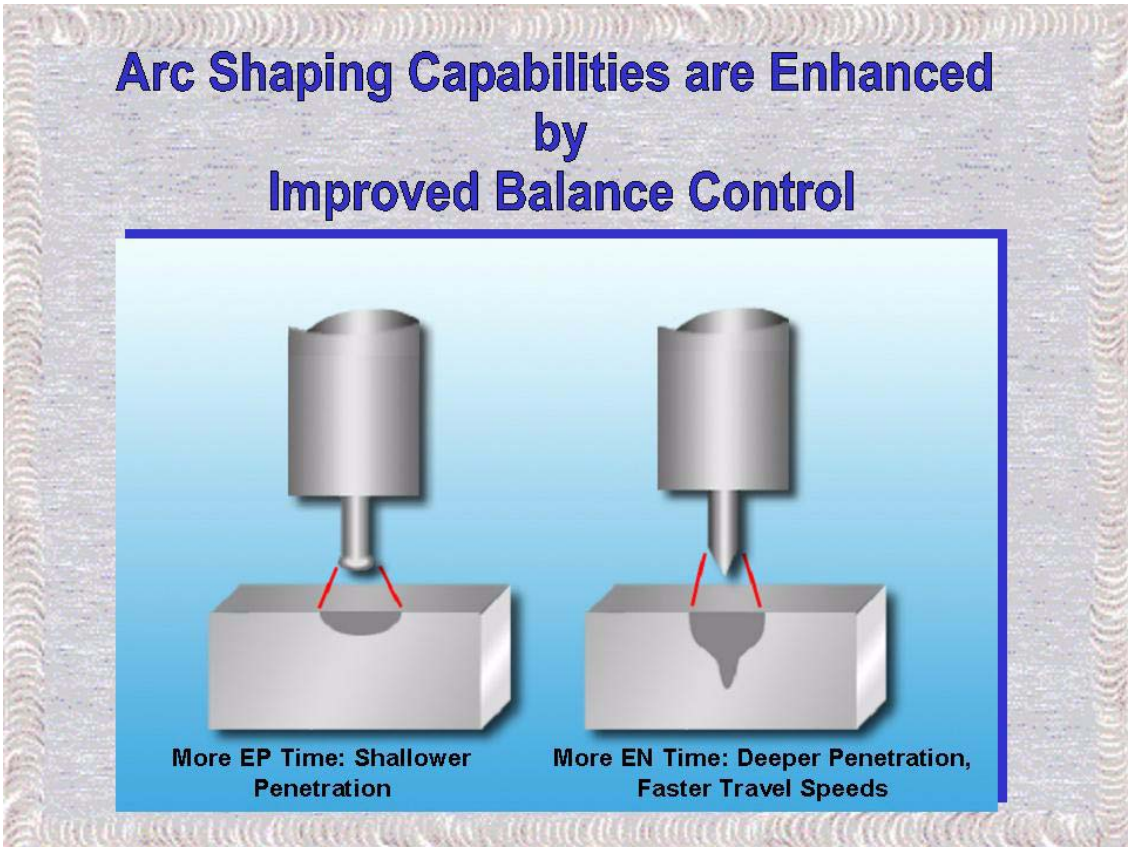


SECTION 3 − ARC SHAPING CAPABILITIES

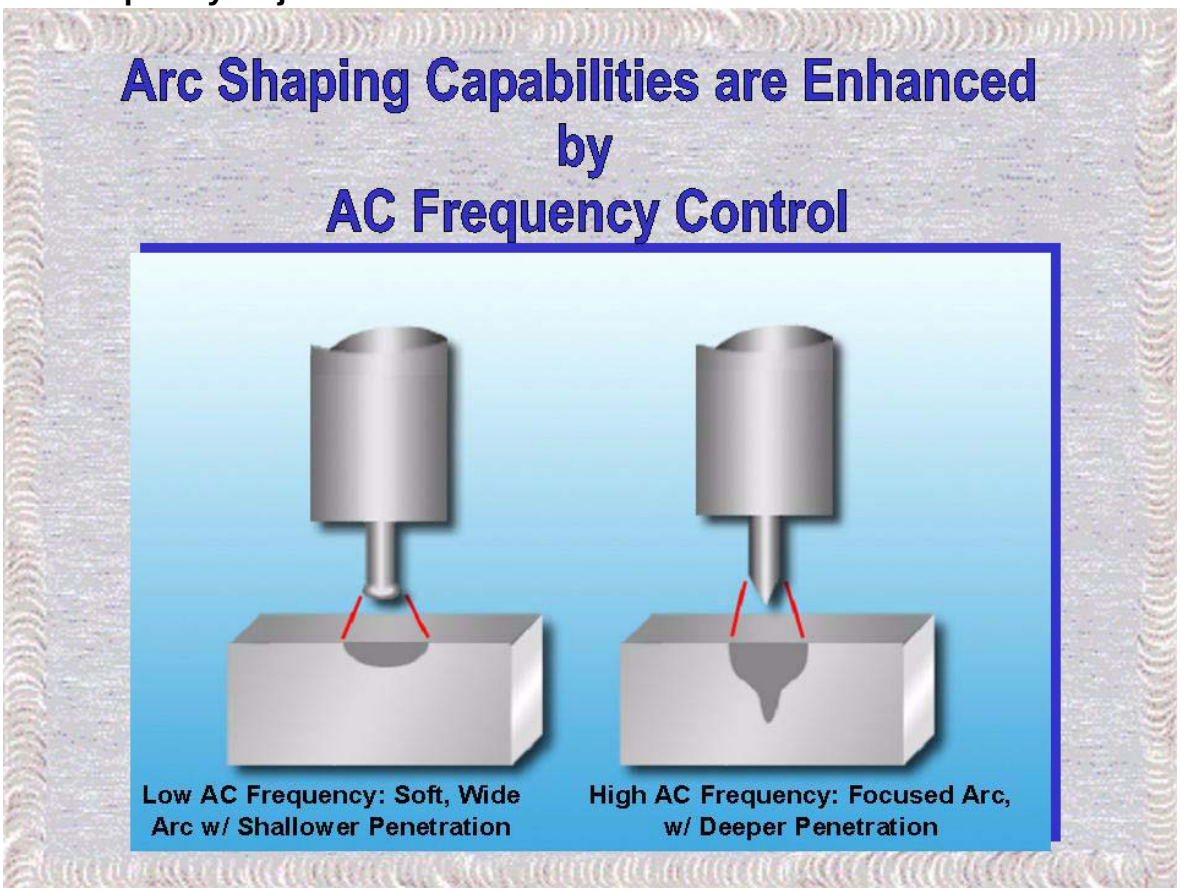
3-1. Arc Starting Methods



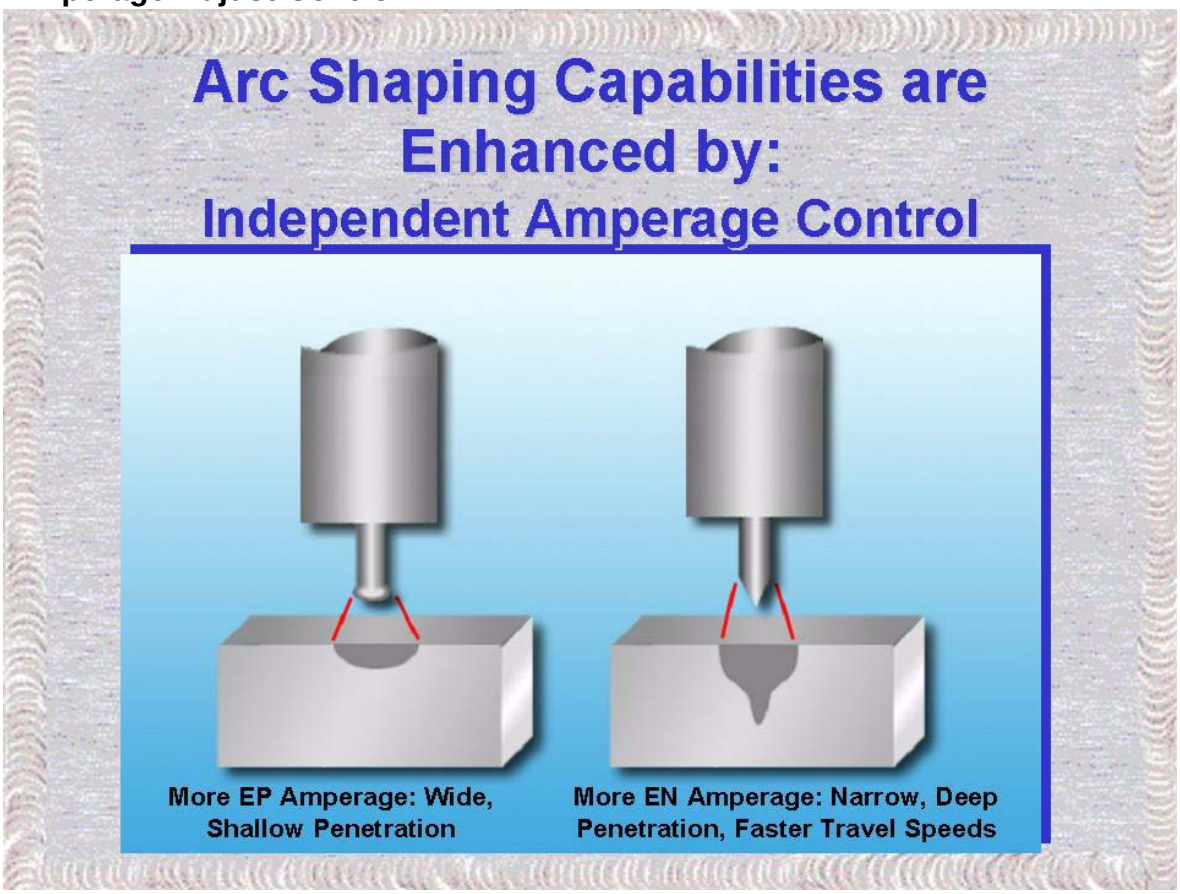
3-2. Balance Control



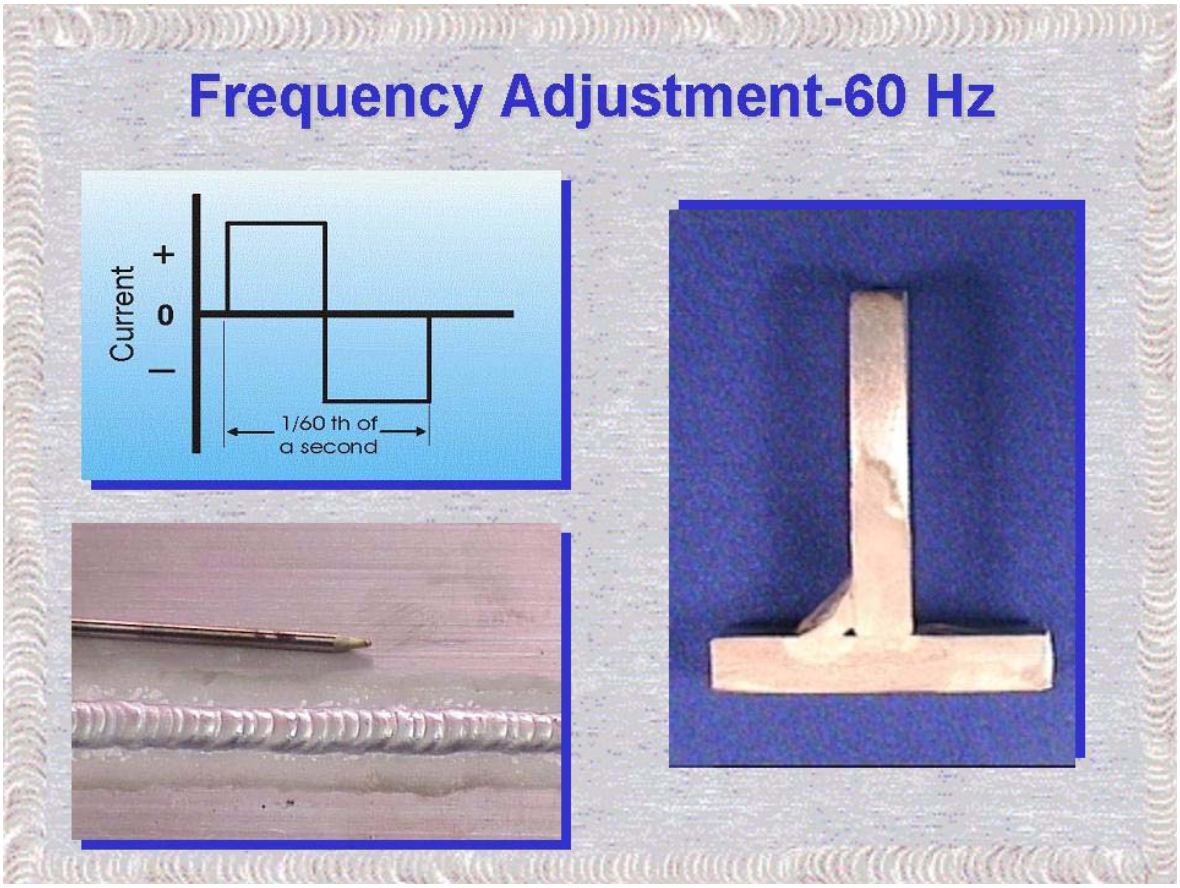
3-3. AC Frequency Adjustment Control



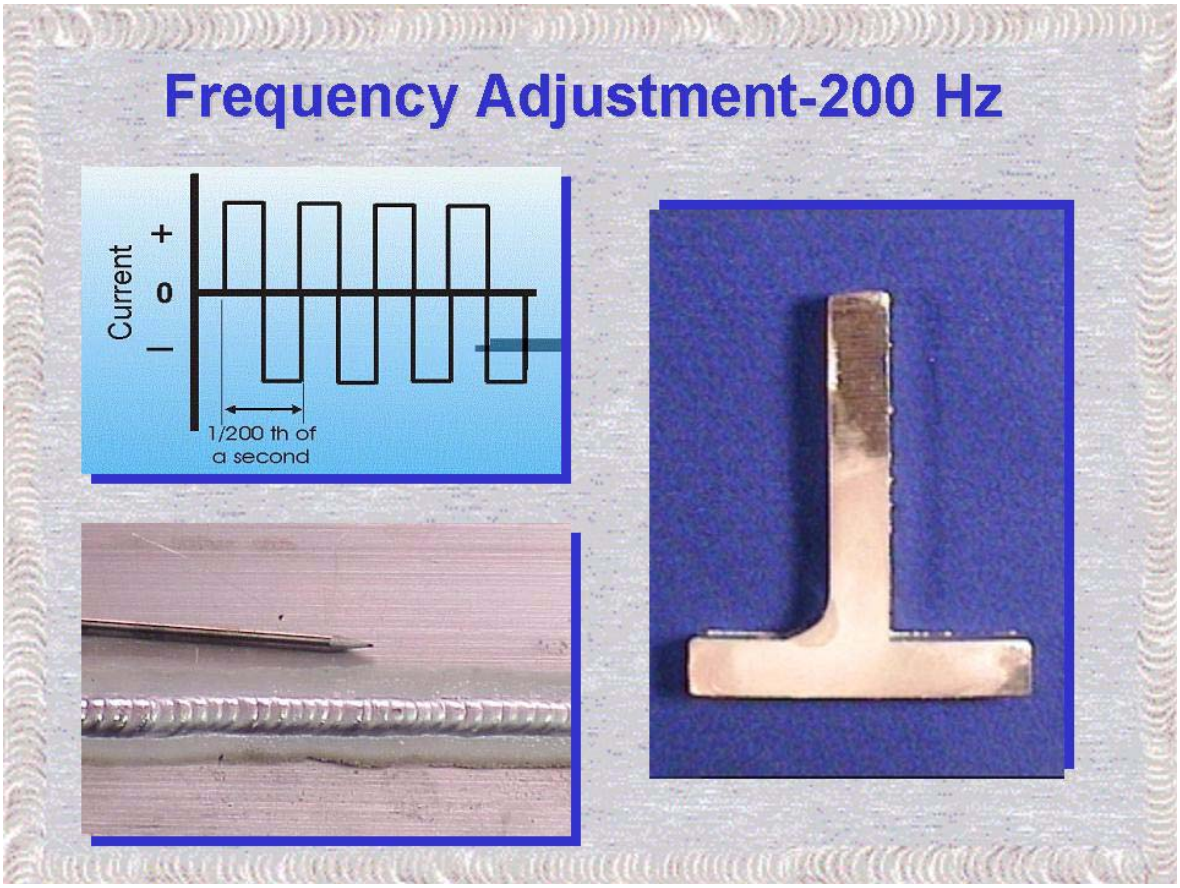
3-4. Amperage Adjust Control



3-5. Frequency Adjustment Control − 60 Hz



3-6. Frequency Adjustment Control − 200 Hz

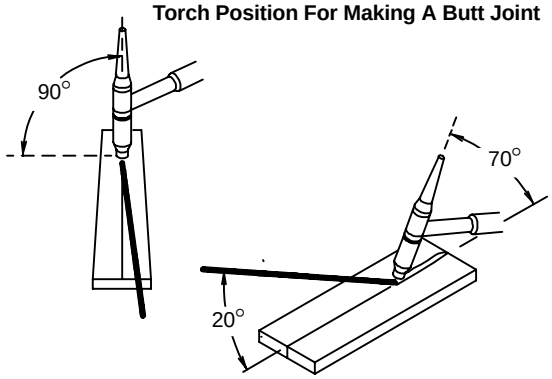


3-7. Suggested Inverter Power Source Starting Parameters For Various Aluminum Joints

Butt Joint

Amperage:	90-120	Base Material Alloy:	6061	Tungsten Type:	2% Ceriated
Balance:	70-80%	Base Material Thickness:	1/8”	Tungsten Diameter:	3/32”
Frequency:	60-120 Hz	Filler Rod Diameter:	1/8”	Shielding Gas:	Argon
		Filler Alloy:	5356	Gas Flow:	15-20 CFH

Torch Position For Making A Butt Joint

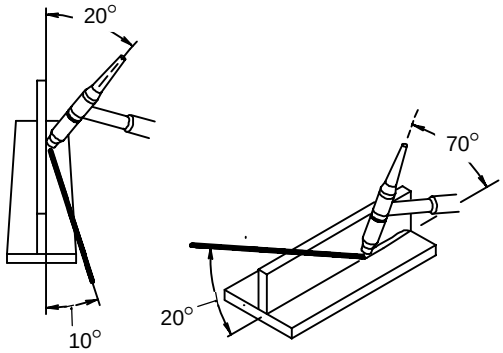


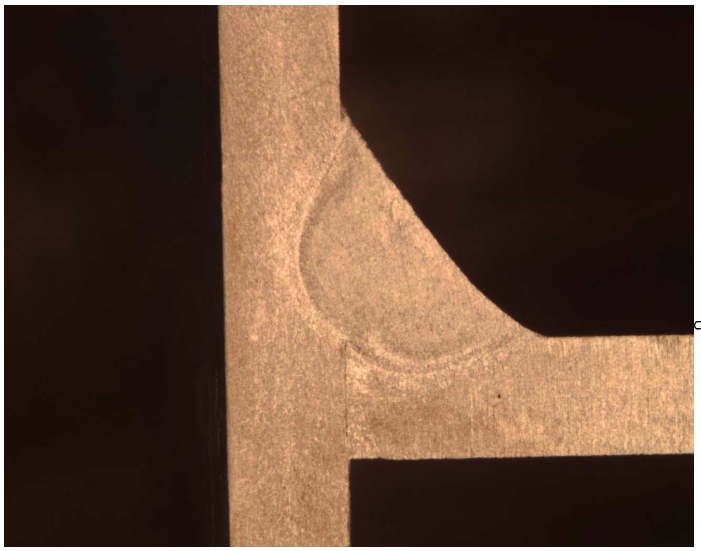
The arc shaping capabilities of our inverter products help produce superior weldments as shown in the photo. This weld was made in a controlled environment. Your results may vary due to things such as operator skill, type of material and material thickness, shielding gas, atmospheric conditions, and joint preparation, etc.

T-Joint

Amperage:	100-125	Base Material Alloy:	6061	Tungsten Type:	2% Ceriated
Balance:	70-75%	Base Material Thickness:	1/8”	Tungsten Diameter:	3/32”
Frequency:	100-200 Hz	Filler Rod Diameter:	1/8”	Shielding Gas:	Argon
		Filler Alloy:	5356	Gas Flow:	15-20 CFH

Torch Position For Making A T-Joint Joint



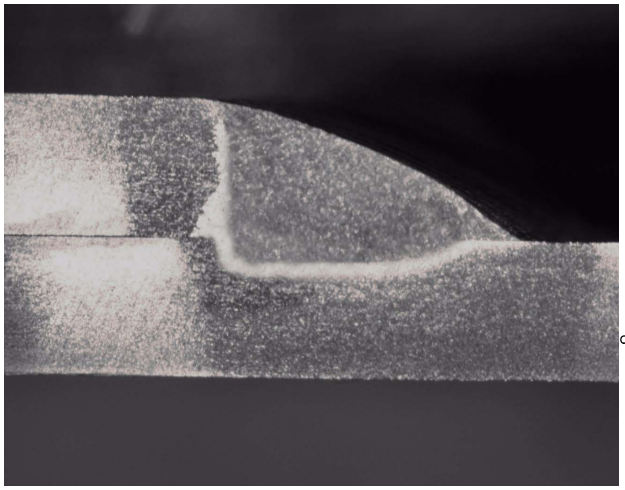


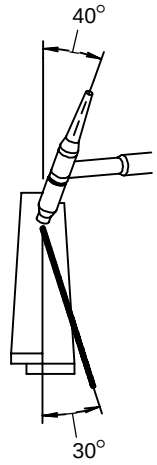
The arc shaping capabilities of our inverter products help produce superior weldments as shown in the photo. This weld was made in a controlled environment. Your results may vary due to things such as operator skill, type of material and material thickness, shielding gas, atmospheric conditions, and joint preparation, etc.

3-8. Suggested Inverter Power Source Starting Parameters For Various Aluminum Joints (Continued)

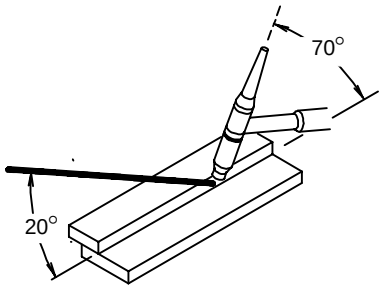
Lap Joint

Amperage:	90-110	Base Material Alloy:	6061	Tungsten Type:	2% Ceriated
Balance:	70%	Base Material Thickness:	1/8”	Tungsten Diameter:	3/32”
Frequency:	100-120 Hz	Filler Rod Diameter:	1/8”	Shielding Gas:	Argon
		Filler Alloy:	5356	Gas Flow:	15-20 CFH





Torch Position For Making A Lap Joint

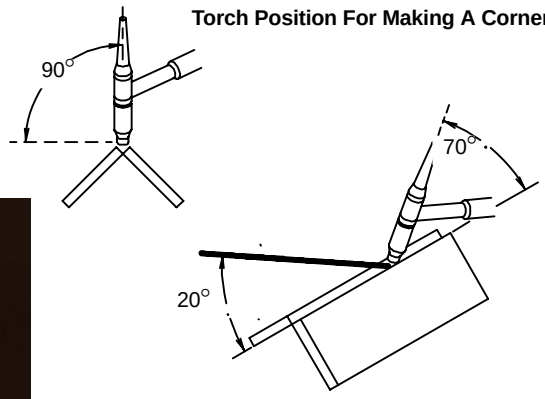


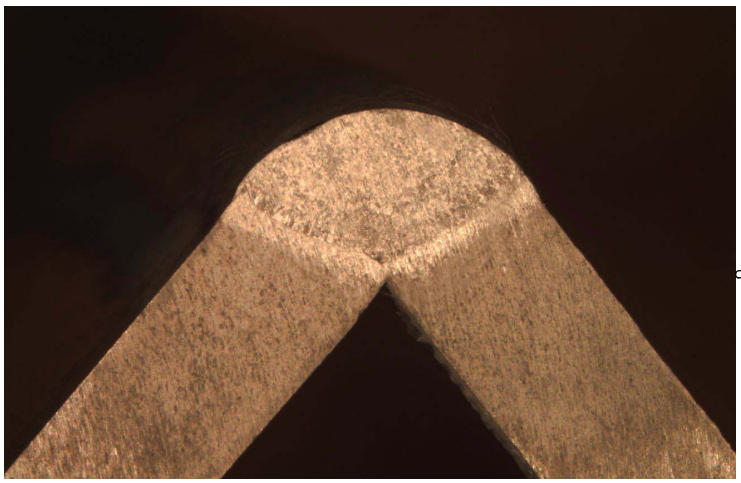
The arc shaping capabilities of our inverter products help produce superior weldments as shown in the photo. This weld was made in a controlled environment. Your results may vary due to things such as operator skill, type of material and material thickness, shielding gas, atmospheric conditions, and joint preparation, etc.

Corner Joint

Amperage:	80-90	Base Material Alloy:	6061	Tungsten Type:	2% Ceriated
Balance:	65%	Base Material Thickness:	1/8”	Tungsten Diameter:	3/32”
Frequency:	100 Hz	Filler Rod Diameter:	1/8”	Shielding Gas:	Argon
		Filler Alloy:	5356	Gas Flow:	15-20 CFH

Torch Position For Making A Corner Joint

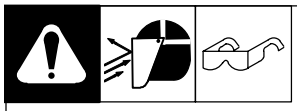




The arc shaping capabilities of our inverter products help produce superior weldments as shown in the photo. This weld was made in a controlled environment. Your results may vary due to things such as operator skill, type of material and material thickness, shielding gas, atmospheric conditions, and joint preparation, etc.

SECTION 4 − TUNGSTEN SELECTION AND PREPARATION

4-1. Safety Information And Selecting Tungsten Electrodes



▲ **Grinding the tungsten electrode produces dust and flying sparks which can cause injury and start fires. Use local exhaust (forced ventilation) at the grinder or wear an approved respirator. Read MSDS for safety information. Consider using tungsten containing ceria, lanthana, or yttria instead of thoria. Grinding dust from thoriated electrodes contains low-level radioactive material. Properly dispose of grinder dust in an environmentally safe way. Wear proper face, hand, and body protection. Keep flammables away.**

Ceriated (orange color coded) and lanthanated (gray color coded) tungsten electrodes are non−radioactive and may offer advantages over traditional tungstens electrodes. The improved heat resistance of these “rare earth” electrodes allow them to be sharpened to a “turncated” point for AC welding applications. They also provide excellent results in DC applications. Miller Electric recommends trying a ceriated or lanthanated electrode for use with a Syncrowave, Dynasty or Maxstar power source. Other considerations in tungsten selection and preparation would be:

- Pure tungsten performs well with a Syncrowave for AC welding applications. They retain a balled end and are highly resistant to contamination. Pure tungsten is generally not recommended for use on “inverter” power sources such as the Dynasty, or on any DC applications.
- 2% thoriated tungsten is a good general use tungsten. However, the thoria contained is a 2% thoriated tungsten is radioactive and has the potential for health risks if not handled properly.
- 2% ceriated tungsten can be used as a non-radioactive substitute for AC and DC TIG welding applications. Ceriated electrodes are characterized by ease of starting, good arc stability, and long life. This universal electrode gives excellent results in AC or DC welding applications.
- 1-1/2% lanthanated tungsten are also non-radioactive, and work well in both AC and DC welding applications. They offer ease of starting, good arc stability, and minimal tip erosion, similar to the ceriated tungsten.

4-2. Selecting A Tungsten Electrode

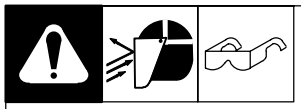
Electrode Diameter	Amperage Range - Gas Type♦ - Polarity			
	DC − Argon − Electrode Negative/Straight Polarity	DC − Argon − Electrode Positive/Reverse Polarity	AC − Argon − Using High Frequency	AC − Argon − Balanced Wave Using High Freq.
2% Thorium Alloyed Tungsten (Red Band)				
1/16”	50-160	10-20	50-150	60-120
3/32”	135-235	15-30	130-250	100-180
1/8”	250-400	25-40	225-360	160-250
5/32”	400-500	40-55	300-450	200-320
3/16”	500-750	55-80	400-500	290-390

♦Typical argon shielding gas flow rates are 15 to 35 cfh (cubic feet per hour).

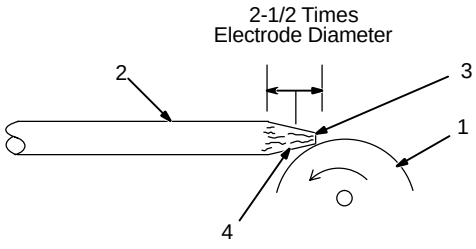
*Not Recommended.

The figures listed are intended as a guide and are a composite of recommendations from American Welding Society (AWS) and electrode manufacturers.

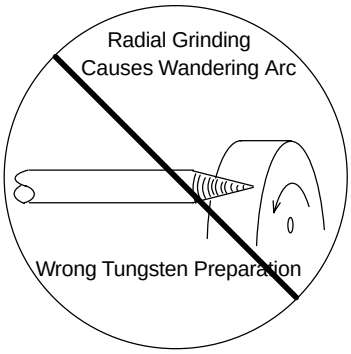
4-3. Proper Tungsten Preparation



A. Preparing Tungsten For DC Electrode Negative (DCEN) Welding Or AC Welding With Inverter Machines



Ideal Tungsten Preparation − Stable Arc



1 Grinding Wheel

Grind end of tungsten on fine grit, hard abrasive wheel before welding. Do not use wheel for other jobs or tungsten can become contaminated causing lower weld quality.

2 Tungsten Electrode

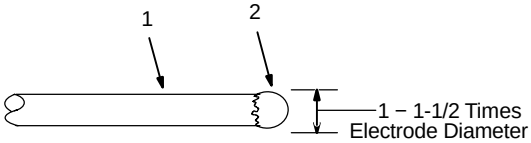
3 Flat

Diameter of this flat determines amperage capacity.

4 Straight Ground

Grind lengthwise, **not radial**.

B. Preparing Tungsten For AC Sine Wave & Conventional Squarewave



1 Tungsten Electrode

2 Balled End

Ball end of tungsten by applying AC amperage recommended for a given electrode diameter (see Section 4-2). Let ball on end of the tungsten take its own shape.

4-4. More About Tungsten Preparation

Historically, preparing to AC weld required selecting a pure tungsten electrode and forming a ball at the end of the electrode. Balling, until now a necessary evil (pure tungsten tends to form a ball), promotes arc wandering, less arc focus and poorer arc starts because electricity likes to come off a point. With a ball, the current can dance around the entire surface. That's why Miller now recommends that, for AC welding, operators should sharpen the tungsten as if they are welding in the DC mode. This is true for all advanced TIG machines, and especially for inverter because it optimizes performance.

Guidelines for preparing a tungsten for AC TIG welding are:

- Select a tungsten with 2% cerium (2% thorium as your second choice).
- Grind the electrode to a point (grind in the long direction, make the point roughly two times as long as the diameter).
- Put a .010 to .030 in. flat (land) on the end to prevent balling and to prevent tungsten from being transferred across the arc.
- For welding thin metals, use a 3/32 in. diameter tungsten.

Compared to a balled tungsten, a pointed electrode provides greater arc control and lets you direct the amperage precisely at the joint, minimizing distortion. With a pointed electrode, a skilled operator can place a 1/8 in. bead on a fillet weld made from 1/8 in. aluminum plates. Without using this method, the ball on the end of the electrode would have forced the operator to make a larger weld bead, then grind the bead down to final size. Thus, when fitting welded parts together, a pointed electrode can save time.

Tips:

Preflow time is used to purge the torch and flood the base material before the arc start.

Preflow time is NOT interruptible and the operator must wait for the preflow time to expire before the arc will start. Preflow is usually used in the weld sequence of metals very sensitive to oxygen and nitrogen of the atmosphere such as aluminum, titanium, stainless steels.

4-5. Tungsten Shape For AC Sine Wave & Conventional Squarewave

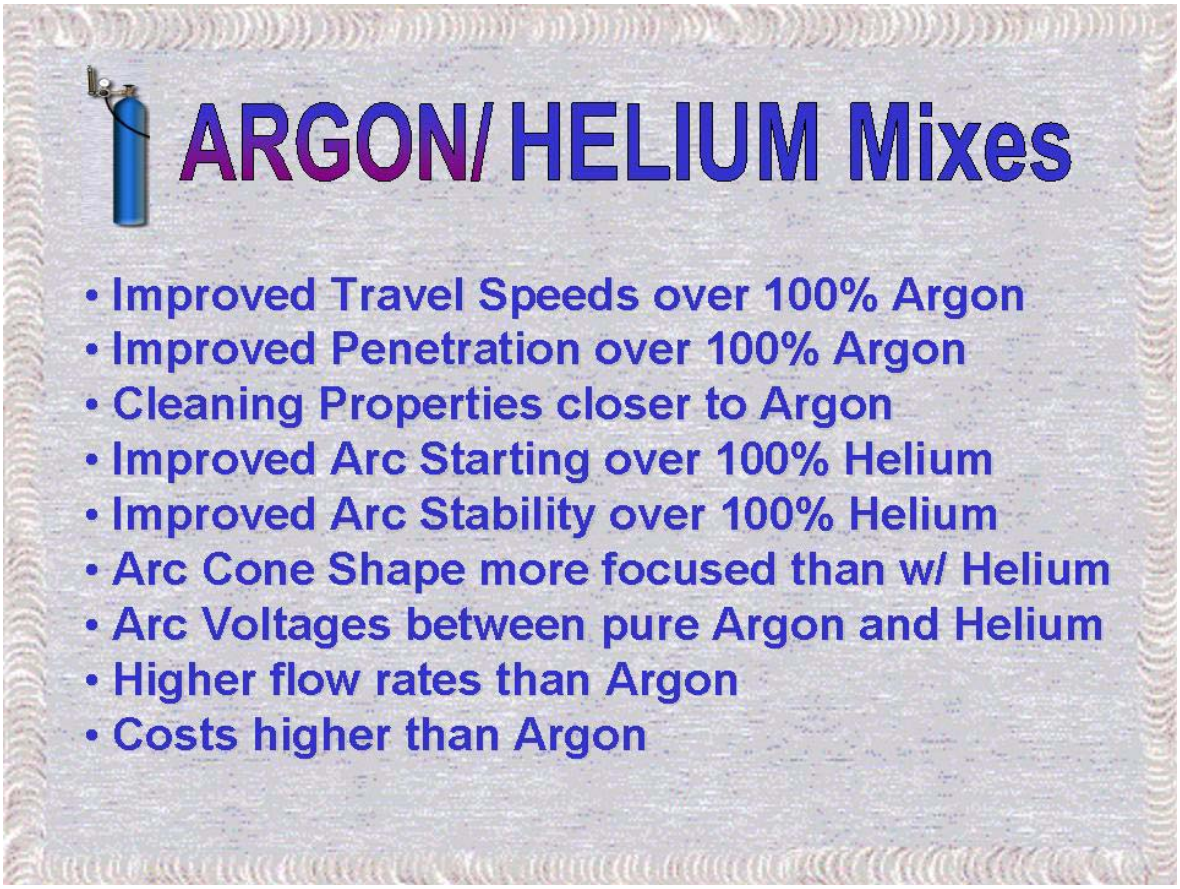
4-6. Tungsten Shape For Inverter AC & DC

SECTION 5 − TIG SHIELDING GASES

5-1. TIG Shielding Gases

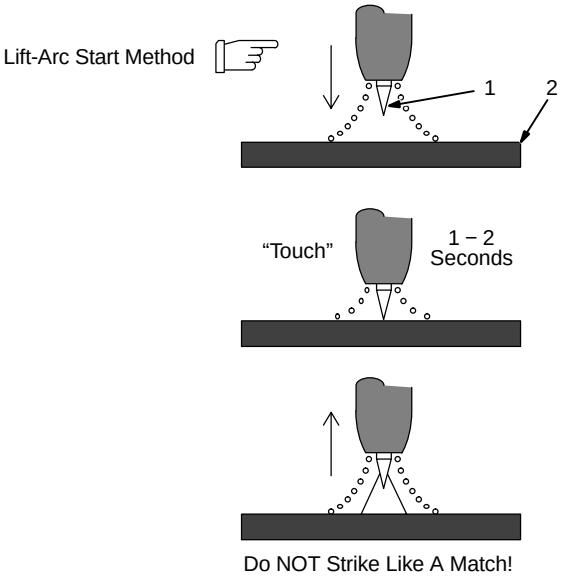
5-2. Argon vs. Helium

5-3. Argon/Helium Mixes



SECTION 6 − GUIDELINES FOR GTAW WELDING (TIG)

6-1. Lift-Arc And HF TIG Start Procedures



Do NOT Strike Like A Match!

Lift-Arc Start

When Lift-Arc™ button light is On, start arc as follows:

1 TIG Electrode

2 Workpiece

Touch tungsten electrode to workpiece at weld start point, enable output and shielding gas with torch trigger, foot control, or hand control. **Hold electrode to workpiece for 1-2 seconds**, and slowly lift electrode. Arc is formed when electrode is lifted.

Normal open-circuit voltage is not present before tungsten electrode touches workpiece; only a low sensing voltage is present between electrode and workpiece. The solid-state output contactor does not energize until after electrode is touching workpiece. This allows electrode to touch workpiece without overheating, sticking, or getting contaminated.

Application:

Lift-Arc is used for the DCEN or AC GTAW process when HF Start method is not permitted, or to replace the scratch method.

HF Start

When HF Start button light is On, start arc as follows:

High frequency turns on to help start arc when output is enabled. High frequency turns off when arc is started, and turns on whenever arc is broken to help restart arc.

Application:

HF start is used for the DCEN GTAW process when a non-contact arc starting method is required.

Tips:

TRUE PULSING

All advanced TIG inverters incorporate pulsed welding capabilities. Pulsed TIG welding is extremely beneficial when welding thin gauge steel and stainless steel. It allows the operator to tailor the amount of heat to the application, decreasing distortion and heat input. Pulsing can also help teach beginning TIG welders because it provides a rhythm for adding the filler rod (i.e., add the filler rod during peak amperage pulse).

For critical applications, discerning operators want precise heat (amperage) control to best prevent burn−through, warping or discoloration.

Welders with true pulsing controls, such as the Dynasty 300 DX, let the operator carefully tailor the pulsed wave form by setting: background amp range, pulse frequency (pulses per second) and peak time adjustment (duration of peak amperage). This gives the operator much more leeway when fine tuning the arc. A series of switch pads lets the operator precisely set parameter values.

Notes