TIG Welding Tips

What is TIG Welding?

TIG (Tungsten Inert Gas)

In TIG welding, a tungsten electrode heats the metal you are welding and gas (most commonly Argon) protects the weld puddle from airborne contaminants. TIG welding produces clean, precise welds on any metal.

- TIG welding uses a non-consumable tungsten

- Filler metal, when required, is added by hand

- Shielding gas protects the weld and tungsten

- Produces high quality, clean welds

- Welds more metals than any other process

{mospagebreak title=Benefits}

Why should I try TIG welding?

1.
Weld more metals and alloys than any other process

TIG welders can be used to weld steel, stainless steel, chromoly, aluminum, nickel alloys, magnesium, copper, brass, bronze, and even gold. TIG is a useful welding process for welding wagons, bike frames, lawn mowers, door handles, fenders, and more.

Build and Repair

Automotive Work

Create Art

2.
Create high quality, clean welds

With superior arc and weld puddle control, TIG allows you to create clean welds when appearances count. Because the heat input is often controlled by pressing on a foot pedal, similar to driving a car, TIG welding allows you to heat up or cool down the weld puddle giving you precise weld bead control. This makes TIG welding ideal for cosmetic welds like sculptures and automotive welds.

No sparks or spatter

Because only the necessary amount of filler metal is added to the welding puddle, no spatter or sparks are produced (if the metal being welded is clean).

No flux or slag

Because the Argon gas protects the weld puddle from contamination, no flux is required or used in TIG welding and there is no slag to block your view of the weld puddle. Also, the finished weld will not have slag to remove between weld passes.

No smoke or fumes

TIG welding does not create smoke or fumes, unless the base metal being welded contains contaminants or elements such as, oil, grease, paint, lead or zinc. The base metal should be cleaned before welding.

TIG Welding

No sparks, smoke, or fumes

TIG Weld - clean, no slag or spatter

Stick Weld - must remove slag and spatter

3.
Use one shielding gas (Argon) for all applications

Because Argon can be used to TIG weld all metals and thicknesses you only need one type of gas in your shop to handle all of your welding projects.

Argon gas is typically used

for most TIG welding applications

4.
Weld in all positions

TIG welds can be made in all positions - flat, horizontal, vertical or overhead. Perfect for roll cages and inside confined areas.

Flat Weld

Vertical Weld

Overhead Weld

{mospagebreak title=Setup}

How do I set up my TIG welder?

See your Owner's Manual for complete safety, set-up and installation procedures.

The following diagram and instructions show a typical TIG welding system and connections.

1. Connect Torch

When using an air-cooled torch, use the adapter from your accessory package and plug the torch into the front of your machine. Also connect your gas hose and regulator.

2. Connect Remote Control

Plug your foot pedal or fingertip control into the machine.

3. Connect Work Clamp

Plug your work clamp (sometimes referred to as a ground clamp) into the machine. Clamp the other end to your work piece or work table.

4. Select Polarity

For aluminum welding, switch your amperage setting on the front panel to AC. For steel and steel alloy welding, switch your amperage setting to DCEN. (For Stick welding, switch your amperage setting to DCEP.)

5. Prepare Tungsten

Grind your tungsten to a point. When welding on aluminum, the tungsten will begin to form a ball. If the ball grows to the same diameter as your tungsten, repoint the tungsten. Grind in the long direction and make the point roughly 2-1/2 times as long as the diameter.

Use a 200 grit or finer grinding wheel. Do not use the wheel for other jobs or tungsten can become contaminated causing

lower weld quality.

6. Assemble Torch

Loosen the back cap and remove the 3/32" diameter tungsten from your torch (it has an orange stripe). Remove the nozzle and copper collet pieces from your torch. Put the collet and collet body back into the torch and tighten. Put the nozzle back onto the torch.

7. Install Tungsten

Place the tungsten into the collet. Leave about 1/8 to 1/4 in. sticking out of the collet (not more than the diameter of the cup). Tighten the back cap.

8. Check and Connect Power

Make sure the power supply you are connecting to matches the rating of your machine (see rating label on unit). If your machine is supplied with a plug, plug it into the appropriate power outlet when you are ready to begin welding.You may need to purchase a plug to match your receptacle. If your machine is not supplied with a plug, connect according to the procedure provided in the Owner's Manual.

{mospagebreak title=How to Weld}

How do I get started TIG welding?

See your Owner's Manual for complete safety precautions and procedures.

1. Safety

Make sure you have all the necessary safety equipment and appropriate clothing. For example,

- Dry, hole-free insulating gloves and body protection

- Approved welding helmet fitted with a proper shade of filter lenses to protect your face and eyes when welding or watching

- Approved safety glasses with side shields under your helmet

- Protective clothing made from durable, flame-resistant material (leather, heavy cotton, or wool) and foot protection.

2. Torch Placement

Hold the TIG torch in your hand at a 70° or 80° angle. Raise the torch so that the tungsten is off of the work piece no more than 1/8 to 1/4 in. Don't let the tungsten touch the work piece or it will contaminate your material and you will need to regrind your tungsten.

3. Foot Pedal Control

Practice controlling the heat with the foot pedal to see the weld puddle increase and decrease. Ideally, you want your weld puddle to be about 1/4 inch wide. Keep your puddle size consistent so it doesn't grow, shrink, spread or narrow while you are welding.

4. Filler Metal

Pick up your filler metal in your other hand so it rests horizontally at a 15° angle from the work piece - not pointed down. Heat up the base metal and gently dab the filler into the puddle. Dab rather quickly so you don't leave large deposits.

{mospagebreak title=Hints & Tips}

How do I TIG weld?

"How-To Weld" Summary

- Establish an arc.

- Create a weld puddle.

- Add filler metal "dip" into the puddle while pushing the weld puddle along the weld joint.

- End the arc and leave the torch over the weld puddle to protect it until the puddle cools.

How do I prepare my weld joint?

- Clean

Cleaning both the weld joint area and the filler metal is an important preparation. Remove all oil, grease, dirt, paint, etc. The presence of these contaminants may result in arc instability or contaminated welds.

- Clamp

Clamping may be required if the work piece cannot be supported during welding.

- Tack weld

Make short 1/4 in. tack welds along the work pieces to hold them together.

How do I position my TIG torch for different types of joints?

Butt welds

When welding a butt joint, center the weld pool on the adjoining edges. When finishing, decrease the heat (amperage) to aid in filling the crater.

Lap joint

For a lap weld, form the weld pool so that the edge of the overlapping piece and the flat surface of the second piece flow together. Since the edge will melt faster, dip the filler rod next to the edge and make sure you are using enough filler metal to complete the joint.

T-joint

When welding a T-joint, the edge and the flat surface are to be joined together, and the edge will melt faster. Angle the torch to direct more heat to the flat surface and extend the electrode beyond the cup to hold a shorter arc. Deposit the filler rod where the edge is melting.

Corner joint

For a corner joint, both edges of the adjoining pieces should be melted and the weld pool should be kept on the joint centerline. A convex bead is necessary for this joint, so a sufficient amount of filler metal is needed.

What can I do to improve arc starting?

- Use the smallest diameter tungsten possible for the amperage you are using. Match the tungsten electrode size with the collet size.

- Purchase the highest quality tungsten available - ask your distributor for Miller-branded tungsten.

- Use a premium quality torch and work leads.

- Keep the torch and work leads as short as possible and move the power source as close as possible to the work.

- Make sure the Stick electrode holder is detached from the machine before TIG welding.

- Check and tighten all connections.

- Keep the torch cable from contacting any grounded metal.

- Use 100% argon shielding gas.

- When welding aluminum, use AC current and a ceriated (orange identifying band) or lanthanated (blue identifying band) tungsten.

- When welding steel and stainless steel, use DC-Straight Polarity (DCEN) and a 2% thoriated (red identifying band) tungsten . Prepare a pointed-end.

- Always use a push technique with the TIG torch.

- When welding a fillet, the leg of the weld should be equal to the thickness of the parts welded.

Why would I use Ceriated or Thoriated tungsten instead of Pure?

With the introduction of new power source technologies, the use of pure tungsten is decreasing.

Pure tungsten melts at a lower temperature causing it to easily form a rounded ball at the tip. When the ball grows too large, it interferes with your ability to see the weld puddle and causes the arc to become unstable.

Ceriated tungsten can withstand higher temperatures and works very well with the new squarewave and inverter machines for the following reasons:

- Holds a point longer and starts well at low amperages.

- Can be used on both AC and DC polarities. When welding aluminum, it has become very acceptable to grind a point on ceriated tungsten (especially when welding on thinner materials).

- Allows welding amperages to be increased by 25-30% compared to Pure tungsten of the same diameter.

Types of Tungsten Electrodes

Type of Tungsten (Alloy)

Color Code

Remarks

Pure

Green

Provides good arc stability for AC welding. Reasonably good resistance to contamination. Lowest current carrying capacity. Least expensive. Maintains a balled end.

Ceriated

CeO_2

1.8% to 2.2%

Orange

Similar performance to thoriated tungsten. Easy arc starting, good arc stability, long life. Possible replacement for thoriated.

Thoriated

ThO_2

1.7% to 2.2%

Red

Easier arc starting. Higher current capacity. Greater arc stability. High resistance to weld pool contamination. Difficult to maintain balled end on AC.

Lanthanated

La_2O_3

1.8% to 2.2%

Blue

Similar performance to thoriated tungsten. Easy arc starting, good arc stability, long life, high current capacity. Possible replacement for thoriated.

Zirconiated

ZrO_2

0.15% to 0.40%

Brown

Excellent for AC welding due to favorable retention of balled end, high resistance to contamination, and good arc starting. Preferred when tungsten contamination of weld is intolerable.

Typical Current Ranges for Tungsten Electrodes

Tungsten Diameter
Gas Cup (Inside Dia.)
Typical Current Range (Amps)

Direct Current, DC

Alternating Current,

AC

DCEN
70% Penetration
(50/50) Balanced Wave AC

Ceriated

Thoriated

Lanthanated

Pure

Ceriated

Thoriated

Lanthanated

Pure

Ceriated

Thoriated

Lanthanated

.040
#5 (3/8 in)
15–80
20–60
15–80
10–30
20–60

.060 (1/16 in)
#5 (3/8 in)
70–150
50–100
70–150
30–80
60–120

.093 (3/32 in)
#8 (1/2 in)
150–250
100–160
140–235
60–130
100–180

.125 (1/8 in)
#8 (1/2 in)
250–400
150–200
225–325
100–180
160–250

All values are based on the use of Argon as a shielding gas. Other current values may be employed depending on the shielding gas, type of equipment, and application.

DCEN = Direct Current Electrode Negative (Straight Polarity).

Recommended Current Type, Tungsten and Gas for TIG Welding

Metal

Thickness

Type of Current

Tungsten

Shielding Gas

Aluminum

All

AC

Pure

Ceriated

Thoriated

Lanthanated

Argon

All

AC Squarewave

Ceriated

Thoriated

Lanthanated

Argon

over 1/4"

AC

Ceriated

Thoriated

Lanthanated

Argon

Copper, copper alloys

All

DCEN

Ceriated

Thoriated

Argon

Magnesium alloys

All

AC

Ceriated

Thoriated

Lanthanated

Argon

Plain carbon, steels

All

DCEN

Ceriated

Thoriated

	Lanthanated			
	Argon			
	Stainless steel			
	All			
	DCEN			
	Ceriated			
	Thoriated			
	Lanthanated			
	Argon			

Additional TIG Resources from Miller

TIG Handbook

Download or order Miller's TIG Handbook - includes the fundamentals of TIG welding, as well as, practical information on techniques used to produce a good weld. A well illustrated 86-page textbook that also contains a wide range of related

subjects such as joint design, weld symbols, weld defects, troubleshooting, and safety.

TIG Welding Articles

Read TIG related welding articles from Miller's Welding Library:

- Important Considerations Before Purchasing a TIG Welder - Q & A
- Choosing a TIG System- Q & A
- Joining Aluminum with GTAW (TIG)
- Successfully Welding Sheet Metal with GMAW (MIG) and GTAW (TIG)

TIG Guidelines Booklet

Download Miller's Guideline to Gas Tungsten Arc Welding (GTAW) Handbook (PDF). This 16-page booklet is a guide to TIG welding basics. Sections on Process, Arc Shaping, Tungsten Electrodes, and Shielding Gases give you the essentials.

Safety Quick-Guide

Download and read our Safety Quick-Guide (PDF) for welding and cutting the safe way! Practical, easy-to-read advice covering a wide range of hazardous situations.

Owner's Manuals

Get the most from your Miller welder by downloading the specific Owner's Manual for your unit. From safety, operations/setup, & maintenance to troubleshooting & parts.

{mospagebreak title=Troubleshooting}

What if I have problems TIG Welding?

The following chart addresses some of the common problems of TIG welding. In all cases of equipment malfunction, the manufacturer's recommendations should be strictly adhered to and followed.

PROBLEM 1: Burning Through Tungsten Fast

PROBABLE CAUSES

SUGGESTED REMEDY

1. Inadequate gas flow.
Check to be sure hose, gas valve, and torch are not restricted or the tank is not out of gas. Gas flow should typically be set at 15 to 20 cfh.

2. Operating on electrode positive (DCEP).
Switch to electrode negative (DCEN).

3. Improper size tungsten for current used.
General purpose tungsten size is 3/32" diameter at a maximum of 220 amps.

4. Excessive heating in torch body.
Air-cooled torches do get very warm. If using a water-cooled torch, coolant flow may be restricted or coolant may be low.

5. Tungsten oxidation during cooling.
Keep shielding gas flowing 10–15 seconds after arc stoppage. 1 second for each 10 amps of weld current.

6. Use of gas containing oxygen or CO2.
Use Argon gas.

7. Tungsten melting back into cup (AC).
If using pure tungsten, change to ceriated or lanthanated .

If machine has Balance Control, adjust setting towards maximum penetration (70-90).

Tungsten diameter may be too small for the amount of current being used. Increase tungsten size.

PROBLEM 2: Tungsten Contamination

PROBABLE CAUSES

SUGGESTED REMEDY

1. Tungsten melting into weld puddle.
Use less current or larger tungsten. Use ceriated (AC) , thoriated (DC), or lanthanated tungsten.

2. Touching tungsten to weld puddle.
Keep tungsten from contacting weld puddle. Raise the torch so that the tungsten is off of the work piece 1/8" to 1/4".

PROBLEM 3: Porosity and Poor Weld Bead Color

PROBABLE CAUSES

SUGGESTED REMEDY

1. Condensation on base metal.
Blow out all air and moisture condensation from lines. Remove all condensation from base metal before welding. Metals stored in cold temperatures will condensate when exposed to warm temperatures.

2. Loose fittings in torch or hoses.
Tighten fittings on torch and all hoses.

3. Inadequate gas flow.
Adjust flow rate as necessary. Gas flow should typically be set at 15 to 20 cfh.

4. Defective gas hose or loose connection.
Replace gas hose and check connections for leaks, cuts, or pin holes.

5. Contaminated or improper filler metal.
Check filler metal type. Remove all grease, oil, or moisture from filler metal.

6. Base metal is contaminated.
Remove paint, grease, oil, and dirt, including mill scale from base metal.

PROBLEM 4: Yellow Powder or Smoke on Cup—Tungsten Discolor

PROBABLE CAUSES

SUGGESTED REMEDY

1. Shielding gas flow rate too low.
Increase flow rate. Gas flow should typically be set at 15 to 20 cfh.

2. Incorrect shielding gas or mixture.
Use argon gas.

3. Inadequate post flow.
Increase post flow time. Set at 10 to 15 seconds.

4. Improper tungsten size or cup size.
Match tungsten size and cup size to joint being welded. General purpose tungsten size is 3/32" diameter and #8 cup.

PROBLEM 5: Unstable Arc

PROBABLE CAUSES

SUGGESTED REMEDY

While DC Welding

1. Weld circuit polarity is incorrect.
Check polarity switch on welder. Select DCEN (Direct Current Electrode Negative).

2. Tungsten is contaminated.
Remove 1/2" of contaminated tungsten and repoint tungsten.

4. Arc too long.
Shorten arc length. Lower torch so that the tungsten is off of the work piece no more than 1/8" to 1/4".

5. Base metal is contaminated.
Remove paint, grease, oil, and dirt, including mill scale from base metal.

While AC Welding

1. Excessive rectification in base metal.
Increase travel speed. Increase balance control toward more penetration. Add filler metal.

2. Improper shielding gas.
In some cases, when welding on 3/8" to 1/2" thick aluminum, argon/helium is used.

3. Incorrect arc length.
Use correct arc length. Adjust the torch so that the tungsten is off of the work piece 1/8" to 1/4".

4. Tungsten is contaminated.
Remove 1/2" of contaminated tungsten and repoint tungsten.

5. Base metal is contaminated.
Remove paint, grease, oil, and dirt, including mill scale from base metal.

6. Frequency set too low.
On welders with adjustable AC frequency, increase frequency to give proper arc stability and direction. 100 to 180 Hertz is acceptable.

7. Improperly prepared tungsten.
With Squarewave and inverter machines, use pointed tungsten. Point will eventually round off after welding.

PROBLEM 6: High-Frequency Present — No Arc Power

PROBABLE CAUSES

SUGGESTED REMEDY

1. Incomplete weld circuit.
Check work connection. Check all cable connections.

2. No shielding gas.
Check for gas flow at end of torch. Check for empty cylinder or closed shut-off valve. Gas flow should typically be set at

15 to 20 cfh.

PROBLEM 7: Arc Wanders

PROBABLE CAUSES

SUGGESTED REMEDY

While DC Welding

1. Improper arc length/tungsten in poor condition.
Lower the torch so that the tungsten is off of the work piece 1/8" to 1/4". Clean and sharpen tungsten.

2. Improperly prepared tungsten.
Grind marks should run lengthwise with tungsten, not circular. Use proper grinding method and wheel.

3. Light gray frosted appearance on end of tungsten.
Remove 1/2" of tungsten and repoint tungsten.

4. Improper gas flow.
Gas flow should typically be set at 15 to 20 cfh.

While AC Welding

1. Improper tungsten preparation.
With Squarewave and inverter machines, use pointed tungsten. Point will eventually round off after welding.

2. Tungsten is contaminated.
Remove 1/2" of contaminated tungsten and repoint tungsten.

3. Base metal is contaminated.
Remove paint, grease, oil, and dirt, including mill scale from base metal.

4. Incorrect balance control setting.
Increase balance toward more penetration. Normal Balance Control setting is 70 - 90.

5. Improper tungsten size and type.
Select proper size and type. General purpose tungsten size is 3/32" diameter and ceriated or thoriated .

6. Excessive rectification in base metal.
Increase travel speed. Increase balance setting toward more penetration. Add filler metal.

7. Improper shielding gas flow.

Gas flow should typically be set at 15 to 20 cfh.

8. Frequency set too low.
Increase AC frequency on machines so equipped to stabilize and direct the arc. The higher the frequency, the narrower and deeper the penetration.

PROBLEM 8: Arc Will Not Start or is Difficult to Start

PROBABLE CAUSES

SUGGESTED REMEDY

While DC Welding

1. No shielding gas.
Gas flow should typically be set at 15 to 20 cfh.

2. Incorrect power supply switch positions.
Place switches in proper positions, either HF impulse or start HF.

3. Improper tungsten electrode.

Use ceriated or thoriated tungsten.

4. Loose connections.
Tighten all cable and torch connections.

5. Incomplete weld circuit.
Make sure work clamp is connected.

6. Improper tungsten size.
Use smallest tungsten possible. Most common tungsten size is 3/32" diameter.

While AC Welding

1. Incomplete weld circuit.
Check work clamp to assure it is securely fastened to work.

2. Incorrect cable installation.
Check circuit breakers and fuses. Check and tighten all cable connections.

3. No shielding gas.
Check for gas flow at end of torch. Check for empty cylinder or closed shut-off valve. Gas flow should typically be set at 15 to 20 cfh.

4. Loss of high frequency.
Check torch and cables for cracked insulation or bad connections. Check spark gaps and adjust if necessary.

5. Improper tungsten size.
Use smallest tungsten possible. Most common tungsten size is 3/32" diameter.

6. Incorrect tungsten type.

Use ceriated , thoriated , or lanthanated tungsten.