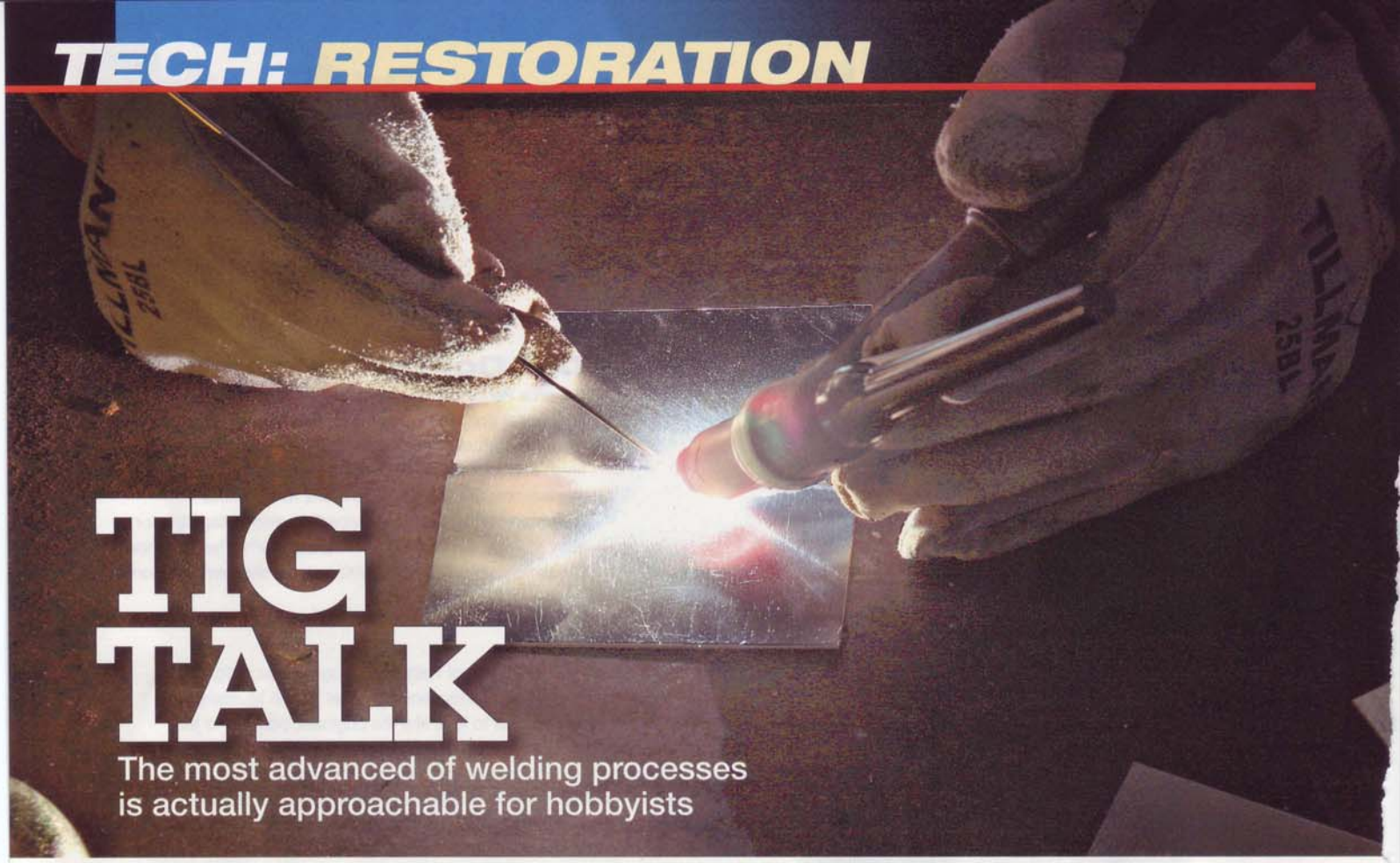


TIG TALK

The most advanced of welding processes is actually approachable for hobbyists

By Mike McNessor
Photography by Terry McGean

Do you really need to learn to TIG weld?

If you're a car or truck hobbyist performing modifications, repairs or restoration work, the practical answer to that is no. Almost any welding project you'll ever stumble across can be tackled with a medium-duty MIG welder and an oxyacetylene torch. The end. Stop reading if that answer satisfies you.

Still here? Good, because simply satisfying one's needs without ever doing something more is a pretty boring way to pass the time. So, do you want to learn to TIG weld? If you're anything like the *HMM* staff, then the answer is a resounding yes.

Why? For starters, TIG lends you the ability to weld exotic metals. Then there's the aesthetics of TIG welding: When done well, TIG welds just look really cool. Finally, there's the challenge of mastering the most precise and most difficult of welding processes.

The fundamentals of MIG welding can be taught in a few hours and learned almost as quickly. TIG takes time to teach, and learning to do it well is a commitment. The good news is, if you already have some gas welding skills, you'll adapt to TIG more quickly than if you've only welded with MIG or Arc. If you've never done any gas welding, don't worry—there's still hope.

Take a class, hit the books

TIG welding, like speaking a foreign language or playing the piano, is not something you're going to teach yourself to do. Take a class or find someone who is willing to spend time showing you the basics, then put in as much time as possible practicing. There are some very good books on the market (see the Sources box at the end of this article) that you should consider reading, but probably not until you've tried your hand at TIG welding or talked to someone proficient in the process. Some of the books currently out there stress the details fairly heavily and might actually scare off the beginner.

HTP America sells a DVD that shows some nice footage of an expert welder TIG-welding aluminum and steel. It also discusses machine setup (of HTP's machines), TIG welding supplies and contains an excellent segment showing some common mistakes. For more information, see the Sources box.

Taking the plunge

When and if you get to the point that you're ready to buy a welder, you're going to find the options dizzying. Unlike the array of hobbyist-level MIG welders on the market, however, there are currently no sub-$1,000 TIG welders out there that will weld aluminum in AC mode. (A DC-only machine used with argon gas will only weld steel.) As of this writing, the cheapest AC/DC TIG on the market is the Miller Diversion—an inverter-based 165 amp welder that comes with a beginner-friendly interface, a regulator, a copy of *TIG Welding for Dummies* (written by Miller), a DVD and a hand-controlled TIG torch with a foot pedal as an extra-cost option. The list price is $1,617, but we've seen it for sale for between $1,300 and $1,500.

The next lowest-cost AC/DC machines on the market are the Miller Econotig AC/DC and the Hobart Tigmate, which sell for between $1,500 and $2,000. Thanks to their simplified operation, these machines are all good for beginners, hobbyists and occasional users. Bear in mind that these are sine wave, not square-wave, machines, and that ease of use comes at the expense of limited operating range.

If you want a TIG welder you can grow into, you need to

spend upwards of $2,000 or start shopping for a used machine. If you decide that used is the way to go, there's nothing wrong with older transformer/rectifier machines like the kind you'll find most often in the under-$2,000 range in classified ads online or in your local newspaper classifieds. They're rugged and powerful, but have a thirst for electricity that your garage's electrical service might not be able to handle—often upwards of 100 amps. They can also be very heavy and almost as large as a washing machine.

Moreover, older machines might not incorporate the latest squarewave technology—something that definitely makes a difference in the machine's ability to weld aluminum well in the AC mode; plus, some experts say it helps the welder operate more smoothly in the DC mode.

The official TIG welder here at Hemmings is the HTP Invertig 201 AC/DC from HTP America Inc. It's an inverter-based unit with pulse and variable AC frequency that's perfect for our needs—it's small, light, and draws just 30 amps, but can handle just about any task we throw at it.

If you've read this far, you've noticed that welders have been characterized as transformer- or inverter/rectifier-based. Inverter machines are much smaller and lighter and, prior to the introduction of Miller's Diversion in October of last year, they were typically more expensive. Inverter machines also draw far fewer amps from the wall, making them better suited to a home shop.

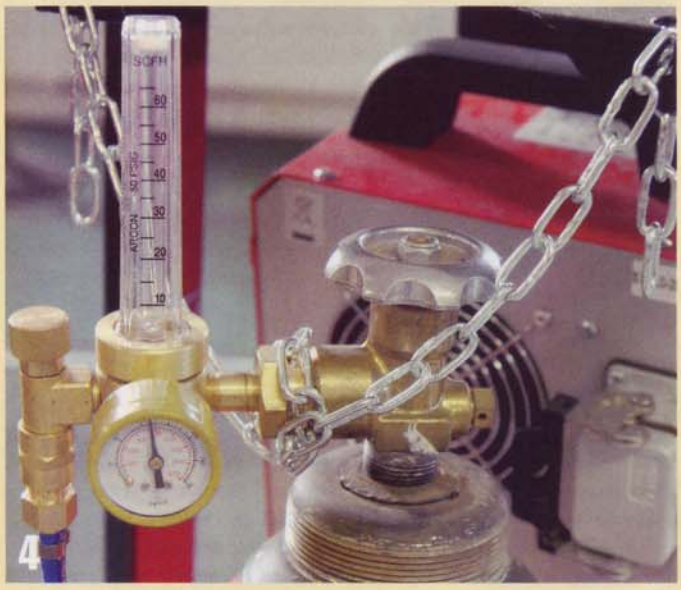
Transformer machines, while big and heavy, have developed a reputation for unquestionable reliability and are still favored by industry professionals, though the advantages of inverter-based machines, particularly power savings, are turning the tides. The manager at our local welding shop says inverter machines are often purchased for their portability, but that he still sells many transformer-based TIG welders.

Confused? Yeah, well, for a beginner, this can be overwhelming. Fortunately, as interest in TIG welding grows, welder manufacturers are now doing a good job of simplifying the myriad choices you have when choosing a welder. Check their online resource material for more insight.

The official TIG welder of Hemmings' shop is the HTP Invertig 201 AC/DC from HTP America Inc. It sells for $2,395 without the cart and is a full-featured inverter-based TIG with pulse and variable AC frequency. It weighs just 68 pounds, is about the size of a desktop computer and draws just 30 amps from the 220-volt outlet.

Shown here in the AC mode, our Invertig 201 allows you to adjust the AC balance from 10 to 90 percent and the frequency from 20 to 200 hertz. In a nutshell, balance determines how much heat goes into the work versus how much goes into the torch, while frequency control allows you to dial in the width of the arc cone from a wide arc at 20 hertz to a pinpoint-narrow 200 hertz.

Argon is used as a shielding gas in TIG welding for almost any application. Helium was originally used in TIG welding, hence the Heliarc name, but was edged out for a few reasons. Among them, helium is more expensive than argon and must be used in greater volume.



We're using a glass tube-type regulator, as recommended by HTP. Flow should be set between 15 to 20 CFH for TIG welding. More gas is not always better: Increasing the gas flow rate can cause turbulence and roll air into the argon, which will create more problems.

Taming the tungsten

TIG welders use a stick of tungsten as an electrode. This is not consumed during welding—the filler rod is considered the "consumable." Tungsten comes in many different flavors, including pure tungsten, 2 percent thoriated, 2 percent ceriated, 2 percent lanthanated and tri-mix tungsten. Zirconium alloy is also used as an electrode for AC welding, but only for specialized applications, due to its cost. At Hemmings, we're using 2 percent ceriated tungsten, which is a good all-around electrode for inverter-based machines like our HTP Invertig 201.

Once you're clear on the type of tungsten to use, you must decide what diameter tungsten is appropriate. Common sizes, in inches, are .040, 1/16, 3/32 and 1/8. A welder will weigh a number of factors when choosing the type and diameter of his or her tungsten, including the type of machine being used, the thickness of the material and the type of the material.

Before working with a tungsten, the business end must first be sharpened to a point. When welding aluminum with a transformer welder, it's common practice to melt the tip of the tungsten into a ball; this isn't necessary with an inverter-type welder. (Some experts, including Richard Finch, author of *Performance Welding Handbook*, say it isn't necessary with a transformer machine, either.)

Grinding the tungsten to a point is easy, but you need to make sure you don't contaminate the electrode with other metals that might be embedded in the grinding wheel. That means having a wheel on your bench grinder dedicated only to sharpening tungstens, or buying a tungsten-grinding tool. You'll want your grinder near the work area, too. Every time you accidentally stick the tungsten in the work or stick the filler to the tungsten, you'll have to clean and re-sharpen it. And in the beginning, you'll be doing this plenty.

A word about rod

When you TIG weld, you make a molten puddle in the work with an arc from the torch and then dip the rod into the puddle. These individual drops of filler, one next to the other, are what form that "row of dimes" bead that comprises a good TIG weld. The makeup of the rod must be compatible with the material being welded. Therefore, there is TIG welding rod for steel, aluminum, stainless steel, magnesium and titanium. Here, we're using ER4043 for aluminum and ER70S-6 for steel.

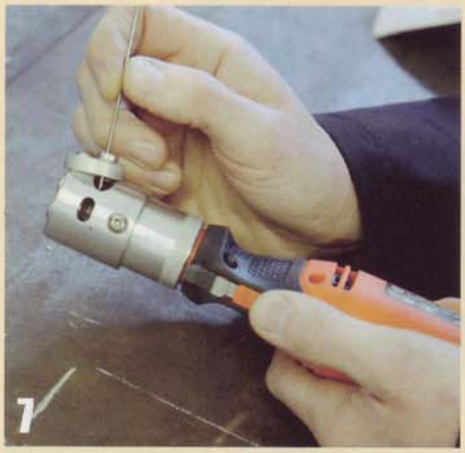
In addition to knowing what type of rod to purchase (consult a book or the staff at your local welding shop), you'll also need to know what diameter to use, which is determined by the thickness of the work. Using too thin a rod on thick material will cause the rod to melt before it gets to the puddle; using too thick a rod on thin material will cool the puddle so the rod won't melt.

5

A variety of rod thicknesses is a must, but we've so far stuck with ER4043 (the silver stuff) on aluminum and ER70S6 (the copper coated stuff on steel). The ER stands for electrode/rod, the next two numbers denote the filler's tensile strength (40 equals 40,000 p.s.i; 70 equals 70,000 p.s.i.)

6

We've been using 2 percent ceriated tungsten (the package in the background) from HTP, which can be identified by a gray tip. It works well in AC and DC modes on a variety of materials and isn't radioactive. The red-tipped tungsten is 2 percent thoriated. It's widely used, most commonly in DC mode, and works well on steel and stainless steel but does carry a low-level radiation hazard. The gold-tipped tungsten is 1.5 percent lanthanated, which can be used in AC or DC modes with any type of machine, whether inverter- or transformer-based.


7

You can sharpen tungsten electrodes on a bench grinder with a dedicated wheel, but once you use HTP's Tungsten Grinder (about $239.95), you'll never go back. It not only sharpens the tungsten quickly and accurately, but it can cut and flatten tungsten as well. Great tool.


8

HTP sells a parts kit for $55; it includes a short torch cap for working in tight places, a variety of tungstens, and collets, collet bodies and cups for .040-, 1/16-, 3/32-, and 1/8-inch diameter tungstens.


9

This is a bead our man ran on light-gauge aluminum with no filler rod. It started out way too hot but ended up okay. We'd give it a C-plus.

Gas basics

One hundred percent argon is used as a shielding gas when TIG welding the most common metals, like aluminum, steel or stainless steel. While aluminum is most often welded in AC mode with argon, it is also possible to weld aluminum in DC mode using helium as a shielding gas, though this is no longer common.

The size of the bottle you decide to rent or buy from your local welding shop will depend on the size of your budget and the amount of shielding gas you plan to use.

TIG technique

After inserting the sharpened tungsten into the appropriately sized collet, you begin welding by starting an arc. If your welder has high-frequency arc-starting capability, you will simply move the electrode 1/8- to 1/16-inch from the work and step on the pedal to begin.

If you are using an older or less expensive machine that requires a scratch or contact start, you should scratch the electrode on a piece of copper (it's common to use a penny) that's lying on the work and then move the torch (and the arc) over to the work. By striking on copper first, you don't run the risk of contaminating the tungsten.

With an arc established, you watch for a molten pool to form—by applying or reducing pressure on the pedal or manipulating the fingertip control depending on your setup, you can increase or decrease the amperage being delivered and thus increase or decrease the size of the puddle.

The next step is to dip the filler into the puddle without touching the tungsten, then move the torch. Dip. Move. Dip. Move. Dip. Move... and so on. It's also possible to fuse metals together using heat from the TIG torch without filler rod, in much the same way one uses the flame from a torch when flow welding with oxyacetylene.

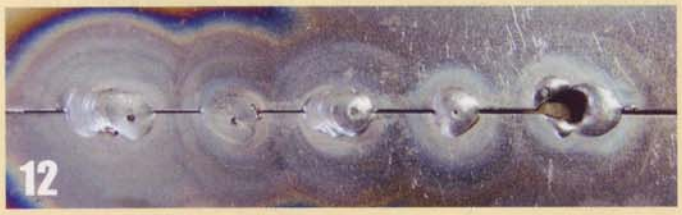
Get busy!

We hope this article has piqued your interest in learning to TIG weld, but this is just the very beginning of what will be a long, sometimes frustrating, but ultimately deeply rewarding process. If you're a hobbyist already familiar with MIG or oxyacetylene welding, TIG is the next logical step in your evolution as a metalworker. TIG will open your eyes to welding in a way that you have never experienced and it will also give you the potential capability to weld almost any metal—and eventually the ability to craft super-strong, elegant welds.

Welding is also a sought-after skill these days, so having the ability to TIG weld could lead to a new or broadened career. If this appeals to you, take the next step: Look up a welding school in your area and make a phone call, ask a friend to show you the ropes, or invest in a book or video. The challenge is considerable, but the payoff is worth it.

This time we added some ER4043 filler rod, and the results were so-so. The weld starts out pretty good (notice the shine), but at about the halfway point, the material became overheated and our man never compensated by backing out of the pedal. The rest of the bead (from the center to the right) is too hot.

The top bead was run on 20-gauge sheetmetal with no filler. Not bad. The lower bead was run with ER70S6 filler rod with reasonably good results. The bead starts well but gets a little shaky and hot as the welder progressed to the right. Practice, practice, practice. B-minus, and that's being kind.



Here's an example of how you might spot-weld a sheetmetal panel on your car with TIG—just don't overheat the metal and let the gap get too wide, as our man did, or you'll end up with a hole to fill. The idea of using small welds every half-inch or so is to prevent distortion. Just go easy on the pedal.

A section of rollbar tubing tacked to 3/16-inch plate with HTP's MIG 200...

And here's a similar setup TIG-welded with the Invertig 201. There's nothing wrong with the MIG welds, but the TIG weld is definitely more uniform and aesthetically pleasing.

Sources:

HTP Welding America
800-USA-WELD
www.usaweld.com

Performance Welding Handbook **by Richard Finch**
How to Weld **by Todd Bridigum**
www.motorbooks.com
800-826-6600