MIG pilot: Brazing is not just an oxy acetylene process and can be done using a MIG or TIG welder. Photos: Ben White and Josh Giumelli

Mastering MIG brazing basics

This month we look at using silicon bronze wire with a MIG welder, and the range of jobs you can tackle with it.

By **Josh Giumelli**

Brazing is an incredibly useful process for joining a range of materials using a bronze filler material and a heat source.

This heat source has typically been an oxy acetylene gas torch, but brazing can also be performed using a MIG (metal inert gas) welder.

The process is probably not well known, but it can come in handy for a range of welding jobs in the farm workshop.

MIG brazing has been used in the automotive manufacturing industry for several years to join high strength steels using a low heat-input process.

Traditional welding can often damage the metallurgical structure of high strength steels, weakening them in the process.

Like MIG welding, MIG brazing is easy to automate with welding robots, and can create strong joins without excessive heat.

BRAZING BASICS

MIG brazing is actually not a welding process at all, as the silicon bronze filler metal melts at a lower temperature than the parent metal and cannot and cause fusion between the two. Instead, capillary action draws the braze metal into the joint where it forms a glue-like bond. This capillary action wets the surface of the bond, with strength coming from the surface area of the join and not fusion between parts.

The lower temperature of the brazing process is a distinct advantage when joining heat-sensitive metals, but also with thin sections, which can easily burn through with regular MIG welding. There is also less risk of distortion, making MIG brazing popular for automotive panel work and restoration.

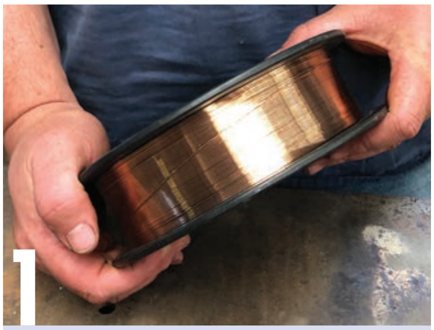
The capillary action can be used to advantage, drawing the molten braze onto a joint which cannot be reached from the other side. It is often used to join two plates together using the 'plug and fill' method and can also bridge quite large gaps in joints which would be difficult with regular MIG welding. In fact, it is often advantageous to have a looser fit between parts to promote the capillary action of the braze metal, adding additional strength to the join.

Of course, there are a couple of disadvantages with MIG brazing over regular mild steel MIG welding. For a start, the silicon bronze wire is several times more expensive than mild steel wire. You also need to use pure argon as a shielding gas, instead of an argon/CO_2 mix as used with steel MIG welding, and for some people this will mean acquiring an additional gas bottle.

MIG brazing is also not suited to joining thick sections of steel, as its main advantage over regular welding is low heat input for thinner sections.

There isn't really an advantage to MIG brazing thick steel as unless it is crack-prone like cast iron, it can handle the fusion heat of regular welding. ▶

SETTING UP



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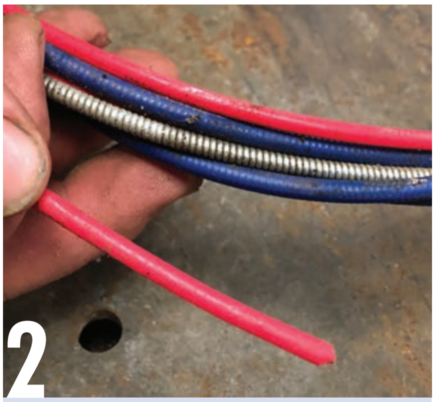
Silicon bronze MIG wire is an alloy containing copper, silicon, tin, iron and zinc. It is more expensive than regular mild steel welding wire, and a 5kg coil costs around $200 to $250. The wire itself is softer than mild steel wire, but not as soft as aluminium wire, and still requires care to avoid feeding problems.



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Teflon liners are often fitted to the MIG welder conduit (or torch lead) in place of the spiral steel liner when welding aluminium to reduce friction. This is ideal for MIG brazing, but not essential.

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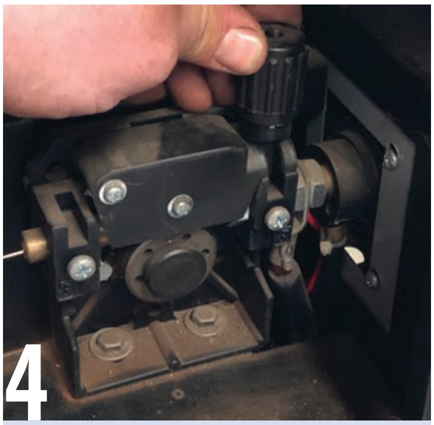
It is important to match the wire diameter with the drive roller groove. MIG welders are usually fitted with V-shaped drive rollers for regular mild steel welding, but U-shaped rollers as used with aluminium wire are best, as they are less likely to squash the softer wire.



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If you must use a V-shaped roller, make sure you keep the tension wound back. Start with a low tension and increase if slipping is evident.

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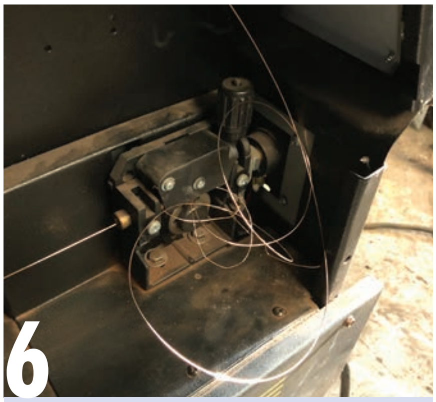
It is also a good idea to fit a new welding contact tip of the correct size when changing over to silicon bronze wire. But leave the tip off while feeding the new wire through to avoid it catching.



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Position the work and the welder so that the conduit runs as straight as possible. Any tendency for the wire to bind will result in a bird's nest tangle and you will have to start again.

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Make sure you are using 100 per cent argon, not 75:25 argon and CO_2. Pure argon is commonly used with TIG welding and is also used when MIG welding aluminium.

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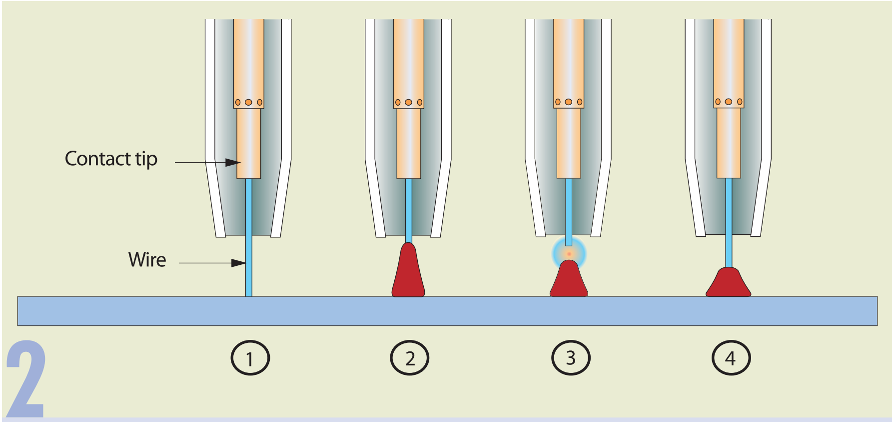
Adjust the regulator flow rate to about 12 litres per minute to start with. This can probably be wound back a little later to save gas, especially if there are no drafts in the workshop.

9

Finally, connect the welding electrode to the positive terminal, which is the same polarity as used with gas-shielded MIG welding. The earth lead should be attached to the negative post.

GETTING STARTED

Machine settings are the tricky part with MIG brazing, as all the adjustments you are used to with plain wire will be different. Remember we are trying to create less heat, so machine settings must reflect that. Start by setting the welder to a lower voltage and lower wire speed than you would for an equivalent mild steel weld.



The correct metal transfer mode for brazing is short circuit or dip transfer. This occurs at lower voltages, where the wire feed is slightly faster than the rate at which it melts. The end of the wire enters the weld pool where it extinguishes the arc, and short-circuits, causing that section of wire to melt and the arc to re-establish.

Run several practice beads on a thin section of metal to get a feel for the wire and to get the settings correct. Use a push travel direction as with normal MIG welding. It is more than likely you will need to adjust the voltage and wire speed down to achieve short-circuit transfer and low heat input. It is easy to determine if the welder is in short-circuit transfer mode as it will sound a bit like frying bacon, rather than the smoother sound of spray transfer which happens at a higher voltage.

There should be no tendency for the weld to burn through the plate, otherwise the input voltage and wire speed need to be wound back. Note the braze bead will have a more pronounced, rounded shape, rather than a flatter bead which is normally associated with correct settings for mild steel welding. If you attempt to adjust the welder settings to achieve a flatter bead, it will overheat the weld pool and defeat the entire reason for using MIG brazing in the first place.

MIG brazing is perfect for welding repairs or fabrication in thin metal, and ideal for welding galvanised steel, where the lower heat input burns off less galvanising. However you still need to watch your heat input. To avoid burn-through or distortion, a weld like this in 1.2mm plate should be done in several steps to keep the heat low.

This weld was performed in three steps with little distortion. Note the overly rounded bead common to MIG brazing. If a flat join is required, such a with panel work, a little clean-up with a flap disc on the grinder will produce good results. One benefit of the braze over a mild steel weld bead is that the braze is far softer, and much easier to grind, sand or file compared to the parent metal.

Don't worry if there is a more joint clearance (or root gap) than normal, as this helps promote capillary action and joint strength. The braze should flow into the joint and around the edges on the back side.

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While MIG brazing is not a fusion process, it can have an equivalent joint strength due to the greater surface area of adhesion, even though the filler metal has a lower tensile strength than mild steel MIG weld.

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MIG brazing is far more gentle for repairs on thin metal, which may have been further reduced in thickness by corrosion. Here we have ground back a rusted panel in preparation for MIG brazing. Note the small patch panel which will be added to the rear of the repair.

10

It is important to use intermittent or step beads to keep the heat input low, otherwise the panel may distort and bulge, which makes the job much more difficult. Here we have placed a section of sheet metal behind the repair section. The braze will flow in between the two panels, provided the panel has been ground back on the reverse side as well. A benefit of MIG brazing over oxy-acetylene brazing is the heat input will be lower for this type of repair.

11

One of the benefits of MIG brazing is its ability to join dissimilar metals, such as stainless steel, mild steel, cast iron, brass and copper. Here we have joined stainless steel plate to galvanised steel. The joint strength is quite impressive as evidenced by our 'scientific' testing methods.

12

Oxy-acetylene brazing is a perfect process for repairing cast iron and can be cheaper than using specialist cast-iron welding electrodes. MIG brazing is just as good, and due to the lower localised heat input, there is less chance of cracking as the joint cools. Start by grinding out a V-preparation along the break.

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Gently preheat the area wit a gas torch if available. Given that this repair is right on the corner, it is unlikely to crack even if brazed without preheat.

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Here we are tacking the piece into place from the underneath side.

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We have kept the heat low during welding, and while the bead looks overly rounded or reinforced, it has wicked into the crack perfectly. Any regular mild steel MIG weld that looked like this would indicate little penetration of the weld join.

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A quick tidy-up with a flap disc makes the repair a lot more visually appealing.