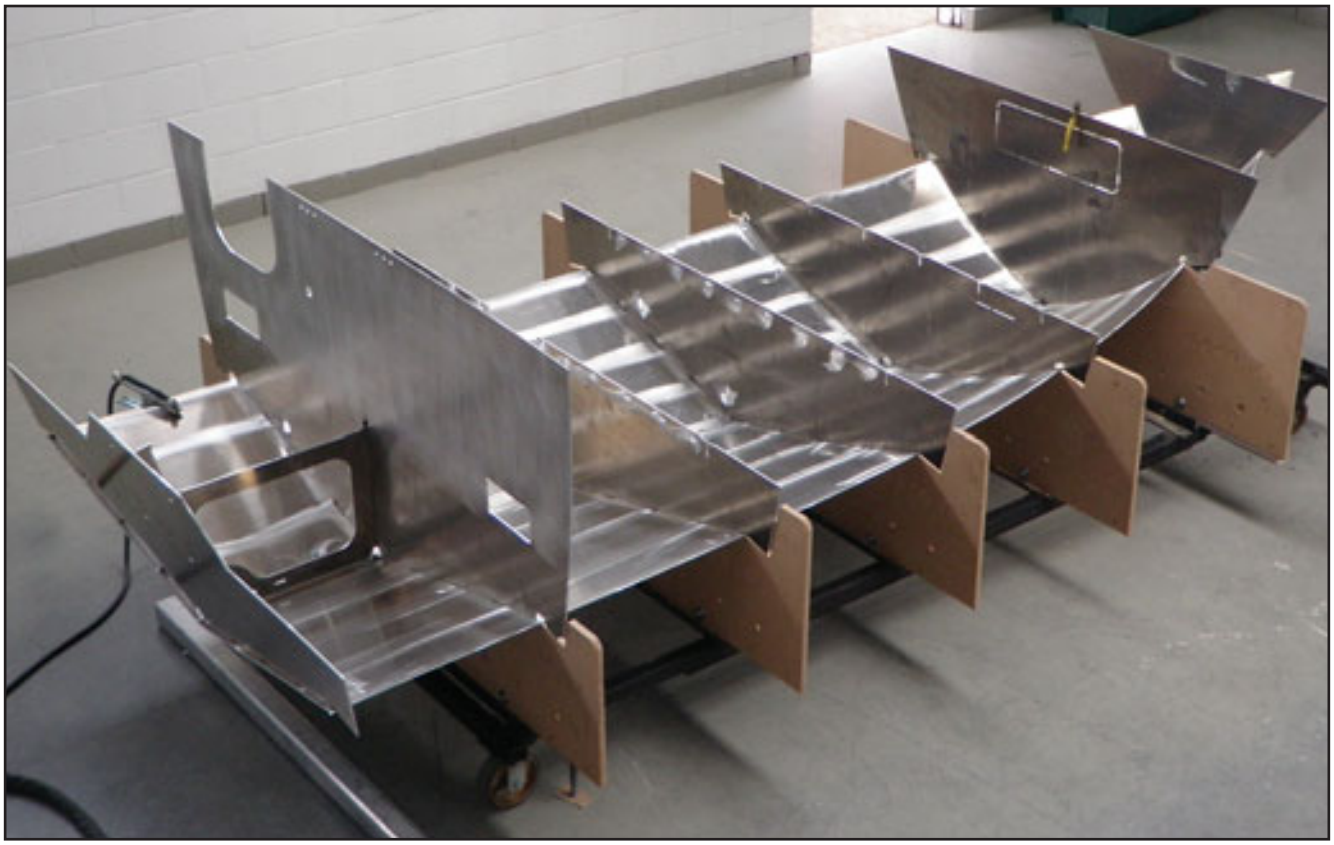


Intro to

P-1 Welding, *pages 70-78*

and then

P-2 Boatbuilding, *pages 80-93*

All about Welding Aluminium. . .

By John Pontifex at Plate Alloy Australia P/L

It seems that the popularity of pre-cut kit boats and the advantages that go with them including custom design, have continued to interest many boating enthusiasts.

After discussions with P.W. about the 4.8m Side Console build article, talk turned to shop and soon we were talking about our boat building courses. I mentioned that due to internet enquiries and PAB reader response, we have now decided to run a one week intensive boat building and welding course, primarily to satisfy interstate demand. *(For those readers interested, we will be posting the course dates on our website, so keep an eye on* ***www.platealloy.com****).*

The week long intensive will be run in addition to the three or four Saturday morning sessions, (8 consecutive Saturdays, 8am-12pm), that we run throughout the year.

Many fishos have been at it long enough to know what they want and need in a boat, and there is the option to get exactly what you want if you build it in aluminium. No expensive moulds, a custom design can have a pre cut kit including seat boxes, dash panel and a sturdy aluminium bait board delivered to your door, the only thing missing is the welding.

We have had enquiries from many readers telling us of their interest and fascination with the idea of building their own boat, and I noted how many mentioned that they have welded steel, but never aluminium, (*"That's me!"* I hear you say), well, Editor P.W. said I can have a few pages to spill my guts about how it is all done, so here goes…

We will start with the welder and how to convert a normal 240 Volt MIG welder to run aluminium, then how to weld aluminium. Also, we will discuss in detail the welds that you will need to practice, (and master), when building a boat.

So for the exercise, as most budding builders are out the back, doing it in the shed, we will use a Unimig 250 amp Inverter welder. This welder operates on 240 Volt (15 amps), and is quite capable of welding up to 6mm aluminium at home. All of our boat kits are manufactured using 4 and 5mm 5083 grade aluminium.

About The Welder

This article is written using one of these welders because yes, we do sell them, but you can purchase them at most good tool outlets. We sell them set up for aluminium, which many do not. The 250 Inverter is an exceptional value for money, entry level welding machine and can also be used to weld stainless steel and mild steel. It is also able to be used as a stick welder.

The compact version is small and portable. There is a larger version with a 4 roller drive feed, which is excellent and the wire feeder part of the welder is better than that of the compact machine, but we prefer the portability of the compact unit. Some information on both of these welders will appear at the end of this article and also on our website.

The information in this article is to be used as a guide, we recommend that all builders attain some formal training in welding, but like cooking, with a little practice most of us are quite capable of doing it.

On a skill level, (I am trying to think of a comparison here), if your eyes are good, and you can thread a 2kg line through the eye of a garfish hook, your hands should be steady enough to perform good welding techniques.

Setting up the welder.

The photos here are of a Unimig 250 Inverter welder.

This is the compact version of the 250 amp inverter machine. This MIG welder has a single roller drive wire feed system and operates on 240 volts. We mount these machines on a stand which is higher than the boat gunnels to allow the MIG gun to gravity feed the wire downwards to the weld area and also reach the centre of the boat.

Welder front view

There are only two controls required to be used when welding aluminium with this MIG welder. One is the voltage (or the power), and the other is the wire speed in metres per minute

Welder description.

The various parts of the welder are detailed below.

Notice that this machine can also be used with gasless wire. This may be of use in an instance when it may be difficult to get a gas bottle to the job.

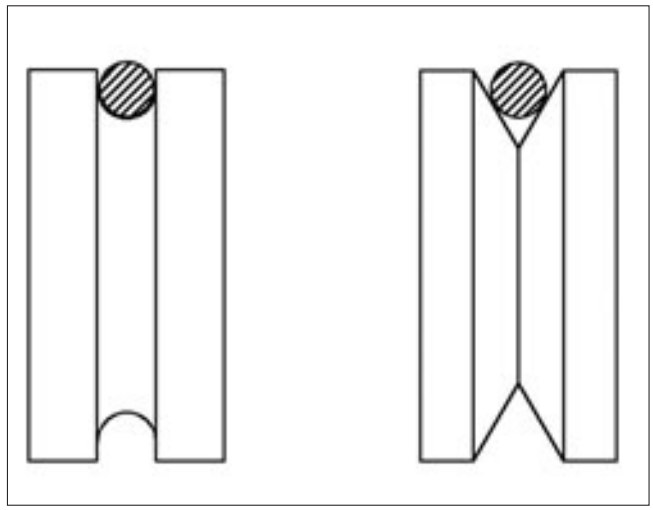
Welder showing wire spool in the machine.

We have tried many brands of wire, and "Safra" is the brand we come back to every time. It is high quality and more expensive, but worth every cent.

Close up of wire brand "Safra"

When bought out of the box, the welder is set up with a liner suitable for steel welding. When welding steel, the drive rollers have a "V" groove profile, the steel wire is hard, and the small contact area on the side of the roller is enough to feed the wire smoothly, not so with aluminium. The aluminium wire is soft and is easily deformed. The wire must be fed through the liner of the MIG gun, through the contact tip and to the weld area. Rollers with a "U" groove profile are fitted when welding aluminium. The rollers are machined precisely for the size of the wire they intend to feed.

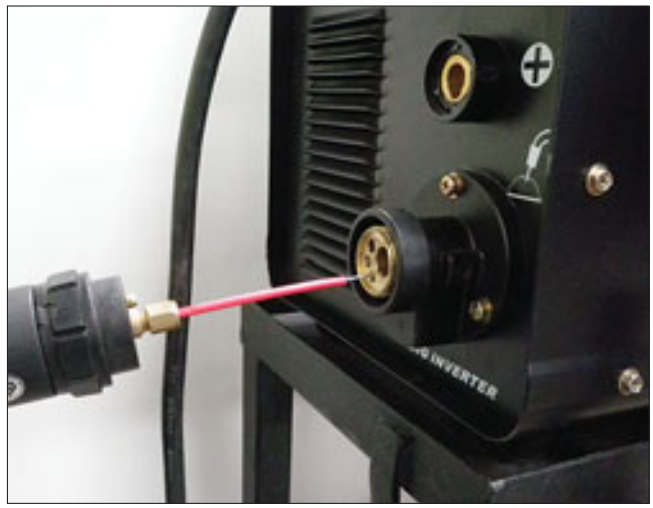
When welding the boats, we always use 1.2mm wire, so we need 1.2 "U" groove rollers when welding aluminium.



Close up of 2 roller profiles

The pictures above show the difference in the roller profiles.

The liner where the wire feeds through to the welding tip must be changed to a low friction liner.



Pic of Teflon liner at euro fitting end

When welding aluminium, and examining weld consistency, most machines fail due to poor and erratic feeding of the wire. A low friction Teflon liner, will reduce the drag of the wire through the MIG gun liner to the contact tip.

The end of the MIG gun where it feeds into the machine is called the fitting end, and in this case, the welder is fitted with a standard "Euro" fitting. This connection is similar in many welding machines which allow different MIG guns to be interchanged if required.

Also it is important to keep the MIG gun and feeder cable fairly straight. Avoid kinks and bend, as each bend will cause the wire inside to rub on a section of the liner and increase friction.

Close up m6 x 1.2 tip

The tips are consumable items, and you will use a few when building a boat. I suggest that if you are going to purchase a welder, buy a packet or two of tips, and ensure they are marked 1.2A – for aluminium.

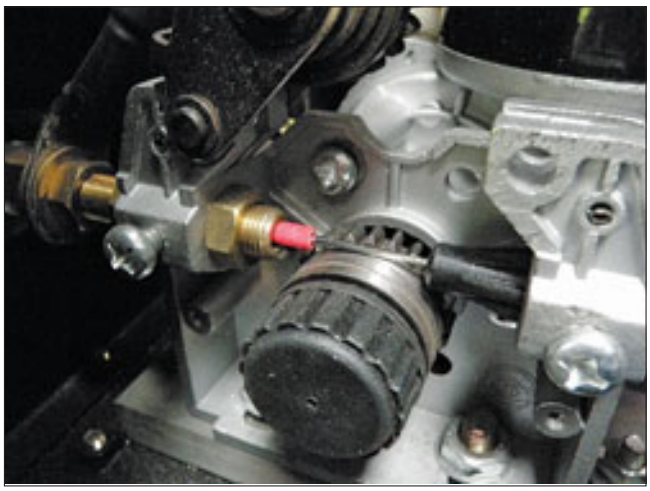
Packet of tips

With the welding setup what we need is smooth low friction feeding of the wire to the welding tip. All these items add up, the liner, the rollers, the oversize tip, the kinks in the feeder cable and the wire quality.

When welding aluminium, we use Argon gas. You can use an Argon blend, and if you visit your local welding supply shop they may advise you to use some special gas mixture for aluminium, but we use pure Argon.

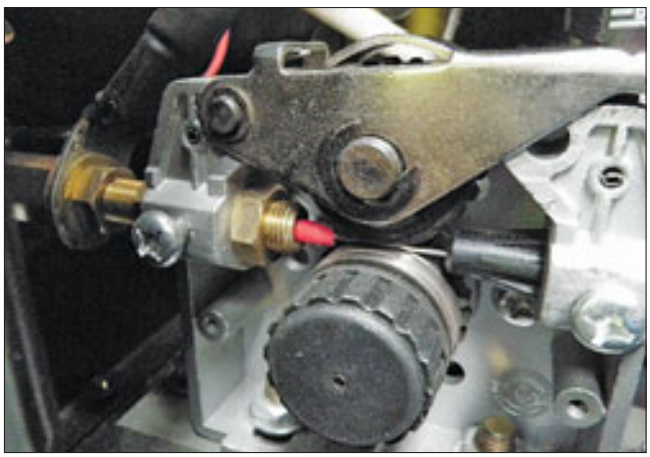
The Setup

Feed the Teflon liner through to the contact tip and trim the liner back 5mm before the roller as shown.



Close up of Teflon liner trimmed

In this picture you can clearly see the trimmed liner and also the gear drive which drives the top roller from the bottom roller. The black knurled knob holds on the "U" groove roller. Notice that there are 2 grooves, the roller can be turned around and is machined for both 0.9mm and 1.2mm. When fitting, ensure that you get the 1.2mm groove aligned the correct way around.



Close up top roller down

In the picture above, it is clear to see the top roller locked into position. There is a very small gap between the two rollers, and the "U" profile of the bottom roller allows the wire to be fully supported and have the most contact area when feeding.

The shielding gas is used to provide an inert environment when welding.

Regulator set at 25 Litres/min

It is important to have the correct amount of gas flowing around the nozzle and tip area. We typically use 25L/min, but if you are unsure, buy a gas flowmeter from your local welding outlet and check the gas flow.

Wire

Wire quality is very important as if the wire diameter varies when it is drawn, also the quality of the wire, ie: the absence of impurities etc, will mean constant tension through the feeder roller, and no high / low spots on the wire to cause increased friction in the liner.

So to recap, we have done 6 things to set up the welder so far.

We will assume 1.2mm diameter wire:

1:Fit "U" groove roller, (or on some machines a pair of "U" groove rollers)
2:Teflon low friction liner
3:Oversize contact tip (1.2A)
4:Argon gas.
5:Adjust gas flow to 25L/min
6: Welding wire 1.2mm, 5356 grade, *(we use only "Safra", for a reason!)*

That's it for the hardware!

Now, before you race down the street and buy these few bits, fit them to the machine and have no joy at attaining good welds and then want to call me to discuss your setup, please remember that we have been welding aluminium for a long time and we are quite familiar with the welders that we sell and more particularly the setup of these machines in particular.

If you have just purchased a welder on an EBay ® auction site, and plan to get into it, please confirm that you can get "U" groove rollers and other parts for the machine. The "U" groove rollers are the item that is most critical, and you may have trouble getting these depending on your machine brand. Contact tips are usually M6 or M8 thread, depending on what size MIG gun you have. And most importantly, can the machine you buy weld aluminium?

We get calls regularly, they go something like this…

Customer: "Hi, I want to build a boat and I was chatting to my mate and he told me about this welder on Ebay®. They are really cheap and the ad says it can weld aluminium, steel, stainless, also steel to plastic, they sound fantastic!

So, I bought it and have later found out that I can't get the 1.2mm "U" groove rollers, and they have this other wire which they say is really good, so I bought that too, but it doesn't seem to work, what do I do?"

Reply: I say politely, "Ever heard this saying, You get what you pay for".

Customer: *(The phone goes a little quiet…)*

I am not trying to scare anyone, but I am being brutally honest here. We do get these calls weekly, and the philosophers are right, you do get what you pay for.

If you get the correct gear and it is setup well, you will have a better chance of having good welding experience.

If YOU feel confident in your ability, then you will want to tackle a boat build of your own, and I can assure you that it is a most satisfying and rewarding personal achievement.

That's what this is all about.

If at all you are in doubt, as we have been told many times before that the sales guy said, "Oh yeah mate, this welder will weld aluminium no worries"… Get them to test it in the shop. If it cannot do the job, and they won't let you test it, DON'T BUY IT!

Welding machines are all different, and some will weld aluminium quite well, and others will not. Please do not call me about your welder, unless you want to buy one. Again I am being brutal here, but this is how it is.

So, if you fancy an experience, take this article into the local welding supplies shop and show them the list of the things you need. They are usually quite helpful but may have trouble getting the rollers, depending what brand of machine you have. And they may also try to sell you a cheaper brand of 1.2mm, 5356 wire. I have told you what wire we use, and will not mention it again. *("**SAFRA**" – there, I said it, once more!)*

We can ship welders Australia wide and will guarantee everything we sell.

So the machine is setup with the correct bits, now it is practice and technique to master the welding process.

SAFETY FIRST:

When welding, always remember safety gear.

Long sleeved clothing, sunscreen (all over the back and under your neck), ears, arms, hands etc.. Protective footwear and long trousers, and eyewear.

NOTE: When welding the insides of your boat, the light will reflect off the aluminium and burn the back of your

neck ears and places you may not think to cover. So apply sunscreen liberally, everywhere that there is exposed skin.

A good quality welding helmet is essential and it is not worth skimping on this vital piece of equipment.

We recommend a helmet that is auto darkening and has variable delay AND adjustable shade.

There are many cheap helmets around, but remember you only have one pair of eyes. Once again, you get what you pay for. What do I use? Speedglas 9100XX. These are $600-+ but I use it daily. We sell a Uni-Mig lower cost helmet, auto darkening and variable shade around $110.

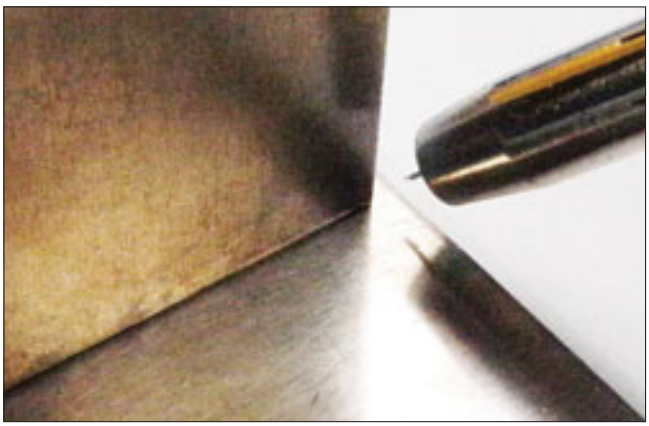
"I heard of one on EBay®", I hear you say…*hmmm*

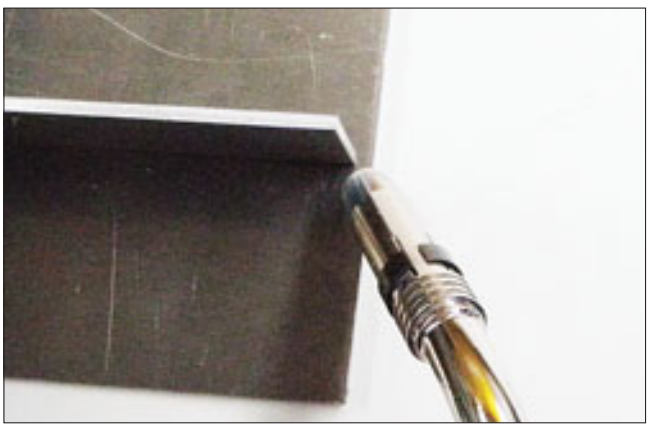
There are 4 types of welded joints you will encounter when welding any boat and these are listed below.

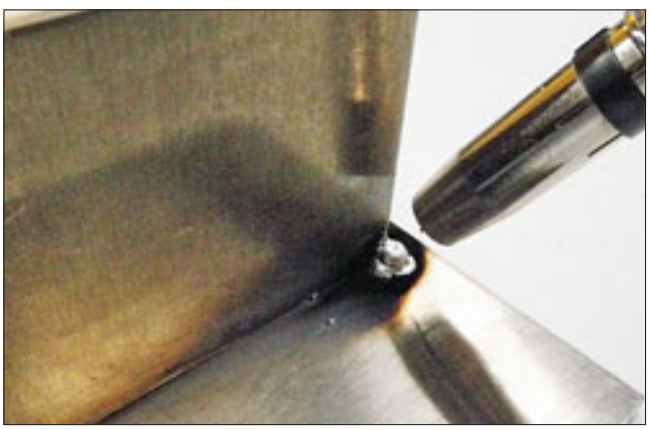
1: Tack weld.

We will use the tack weld as the first example.

When tack welding, the welder can be turned up a little to achieve better penetration. In most instances, the weld tacks







are small and so a higher heat setting is acceptable as the weld time is short.

The tack weld is used to hold material or parts into place. When assembling the boat we recommend to tack the entire boat together. Sometimes you will be tacking a stringer in place, other times a butt joint, or a corner to corner joint. With a tack, you are welding a small area of metal and for a short time, so the welder can be turned up a little higher to ensure adequate penetration of the weld.

2: Fillet weld.

These welds are used when stringers meet bottom plates, also where the sides meet the frames. Where shelves are welded in, these welds are also used. In many instances,

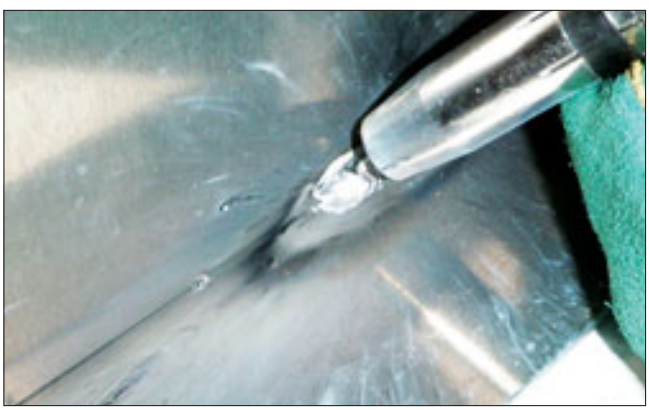
parts are intermittently stitched with a 50mm weld at 150mm spacing.

This picture shows the weld completed. Notice the angle of the MIG gun, and the distance from the nozzle to the weld area. The welding operation is performed from right to left.

You can also see small burn marks where balls of hot metal have rolled away from the weld area. Hence the requirement for safety boots, long trousers and sleeves.

Clean up the weld and remove the carbon from the weld area with a stainless steel wire brush.

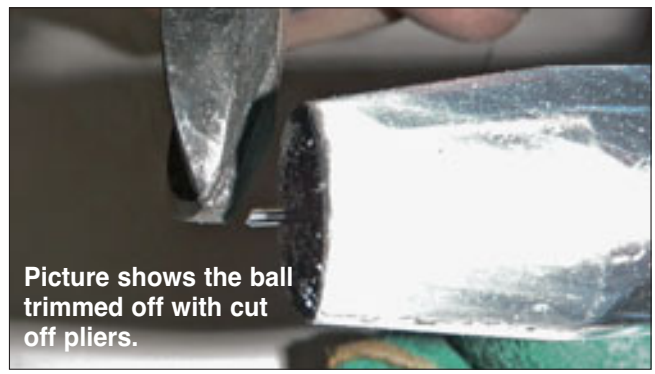
Before each weld trim the ball from the end of the MIG



gun nozzle where the wire exits.

These pictures show a sequence when doing a typical fillet weld.

When the weld is finished, it is good practice to snip the end of the wire protruding from the MIG gun nozzle. After the welding operation, sometimes a ball appears at the end of the wire. To get a better weld start, you must remove this ball.

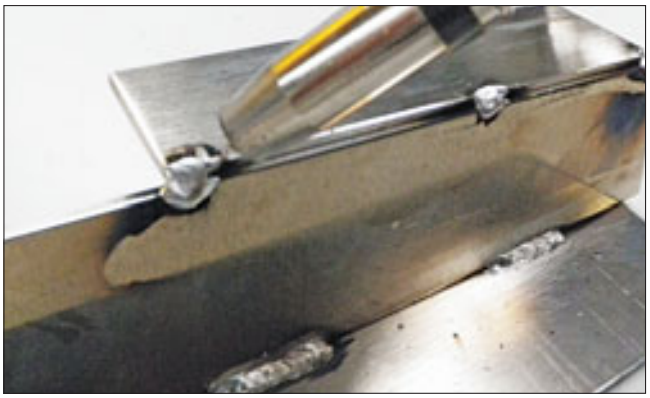


Picture shows the ball trimmed off with cut off pliers.

Our sample piece finished with 3 fillet welds. A quick wipe with a wire brush and all the black marks will be gone.

3: Corner to Corner weld.

The corner to corner weld is performed where the bottom plate meets the chine, and also where the side plate meets the gunnel plate. With the bottom plates, the sequence is to tack the entire boat in position. Then brace any large flat panels with a strong back, (a flat bar perpendicular to the plate used to stiffen the plate whilst welding), before welding. We do the internal welds first, then we sand, back cut the outside edge, and wire brush before performing the final external corner weld



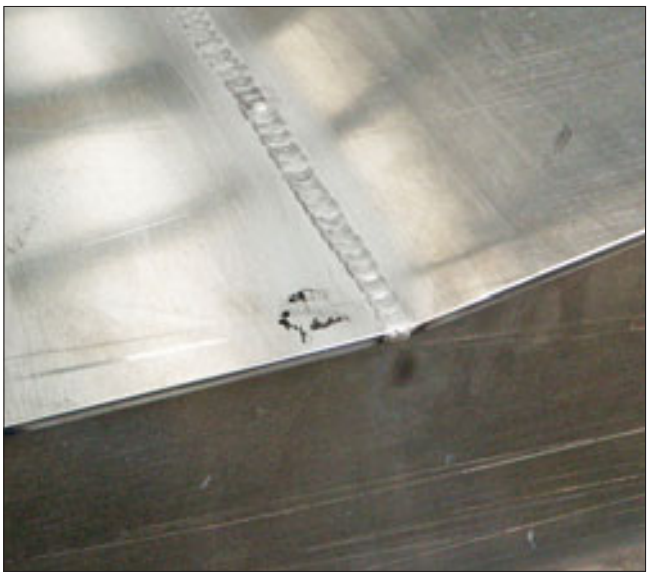
Gareth is preparing the keel weld area by sanding first, then back cutting and cleaning before the final weld.

This corner has been fully welded on the inside. The outside welds are sanded down then back cut before final welding.

This photo shows the tool we use for back cutting. It is an air grinder with a metal cutting blade. These tools are excellent for removing large amounts of material quickly and without depositing grinding wheel material in the groove. These tools are also VERY dangerous and we would not recommend an inexperienced operator to use them.

Left: The photo shows a ripple finish or a weave on the left and a flat weld motion on the right. These results can be easily attained with a little practice.

The picture above shows the corners prepared for the final weld.



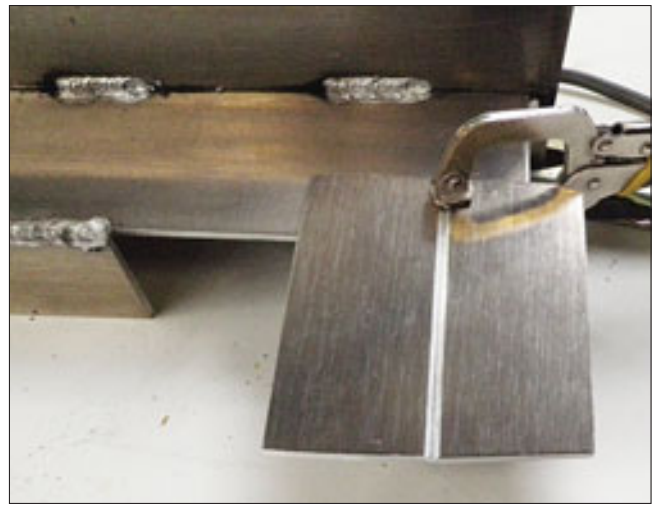
The finished welds require cleaning and external sanding if desired. After leak testing, commercial boats would be finished at this stage. On the inner chine weld we would remove the high spots, (stops and starts), and we may sand the external edge for visual appearance.

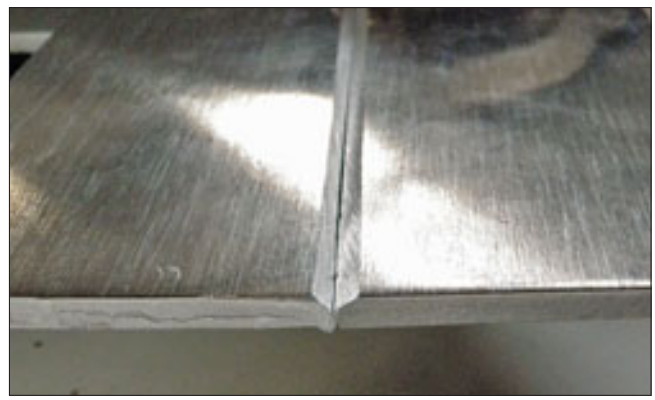
4: Butt weld.

The butt weld is used to join side plates on the larger boats, and also the keel and inner chine.

When a butt weld is performed, after tacking one side, the other side must be back cut as preparation before welding.

Also, after preparation, we tack weld side one, then if possible, flip the part over and back cut side two and fully weld that side. Once this is done, back to side one, sand off tacks, back cut, clean and weld the first side.





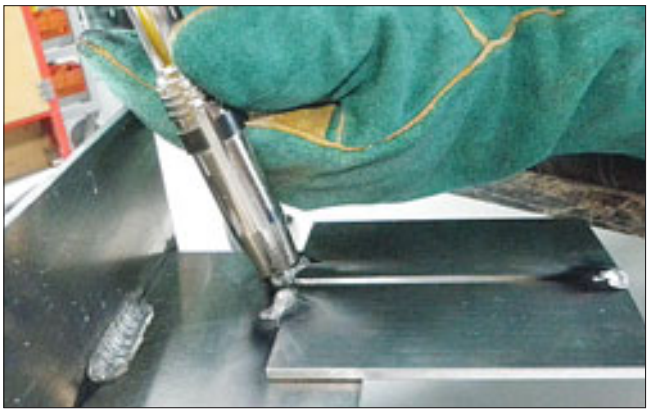
Close up view of edge preparation in readiness for butt weld. We will assume the plates are tacked on the back side for this example.

Side view showing the MIG gun angle when doing the butt weld.

Another side view showing the MIG gun angle when

doing the butt weld.

Weld is finished and can be sanded if desired.



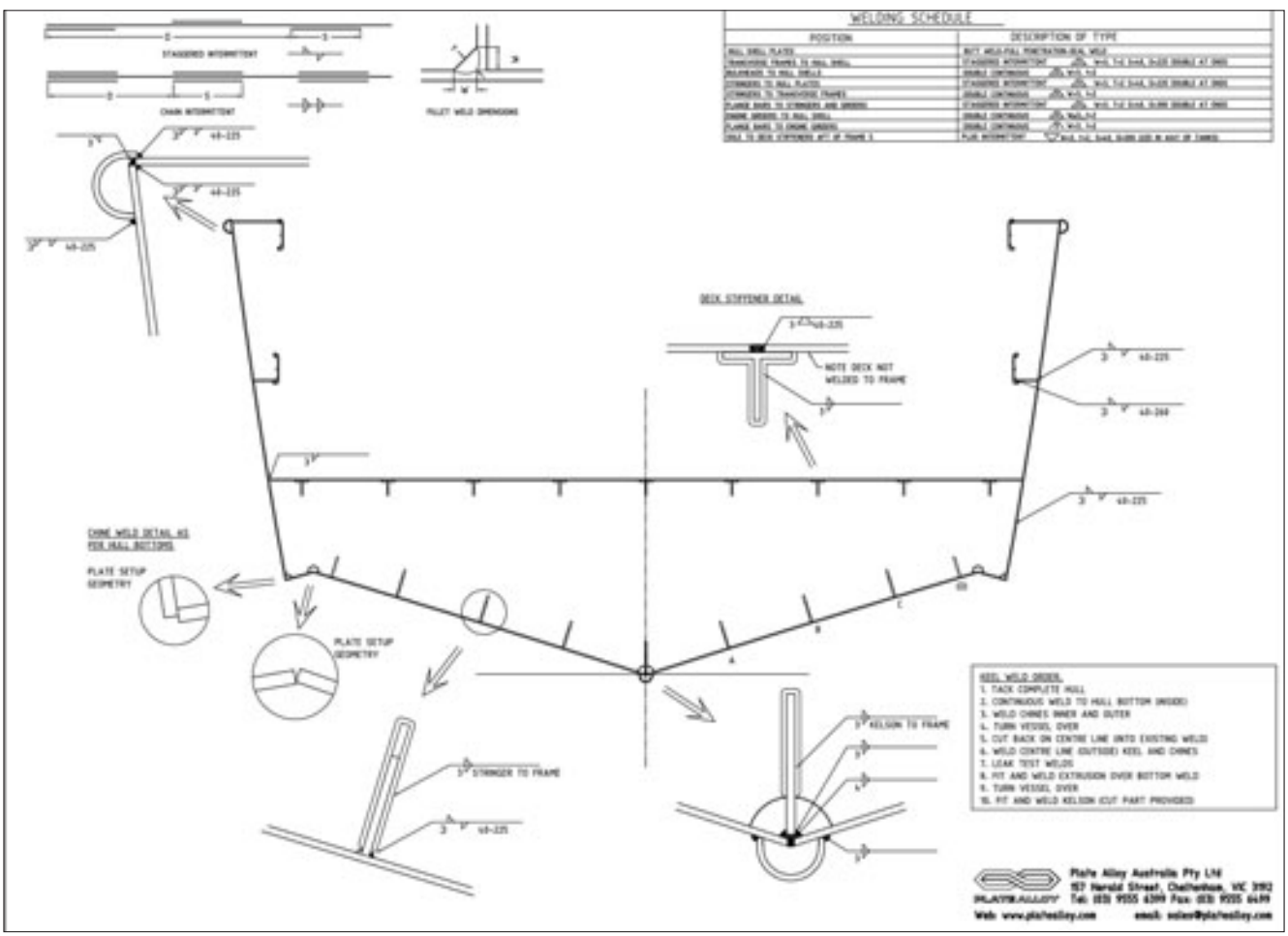
It is important to produce not only a weld that looks nice, but has enough penetration, and does not leak.

I would recommend to do a sample of each, then cut the weld area in half and sand it on a sander. You will see the amount of penetration and you will get a feel of the current setting required to achieve such penetration. This is all about practice. Just keep at it, it first it may look a little rough, but it should get better quickly as you feel more comfortable with the speed of hand movement and the machine settings.

Have a play with different settings on the welder, changing one parameter at a time and experiment.

When welding a boat, you must fully weld some joints, and other welds are staggered welds. The chart below shows the typical weld requirements when welding a vessel.

PAB-5



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