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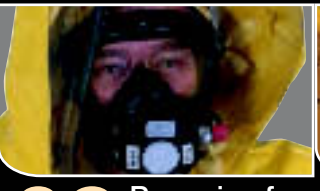
WELDING UNDERWATER



SPOTLIGHT ON...

Welding underwater

no not submerged arc, but actually welding wet, underwater. How is that possible, I bet that's tricky?

I am now in my 30th year of working in the welding industry and my 20th within the subsea sector and I still get asked this question. Funny how something so basic never even raised an eyebrow for me, but for others outside the industry it seems such a normal question.

Photo 1
The photo shows a before and after training example.

Don't worry I won't bore you all with an in-depth 'techno' answer, but just provide you with the basics. Underwater 'wet' welding as the name implies is welding wet, with the diver wet, as opposed to underwater welding 'dry' in a habitat, or cofferdam.

Firstly I should point out that although I've been welding underwater for more years than I care to remember, and apart from the odd minor shock suffered in the early days I have not had any problems since. All my problems came from my training days, up in Scotland. Sad to say so, but back in the good old days when men were men and all that the training schools were all run by ex-military men on a military basis and unless you suffered you couldn't learn.

HOW WRONG CAN YOU BE!

Enough of the good old days, back to the question in hand. Simply put, underwater wet welding can be conducted safely (within reason) providing we follow a number of simple rules. (See AODC 035 code of practice) These will include the type and direction of current, the voltage, the use of double insulated welding cables and a suitable electrode holder, etc. It goes without saying the diver should be insulated from the current, although this is easier said than done sometimes.

The truth of the matter is that underwater wet welding cannot be made completely safe, but by adopting a welding technique in which the return is sound and connected as close as possible to the point of welding together with holding a stance in which the diver remains outside the leakage field we are able to weld safely. There are of course other considerations, such as a 'knife' switch to isolate the current to the diver until required, insulated electrodes, use of appropriate diving suit and gloves, etc.

I BET THAT'S TRICKY?

The question I have considered myself, is one of skills training, (including safety issues) perhaps because I considered my early training so inadequate. The truth of the matter is, to learn how to weld underwater is a difficult task and today's trainee divers do not generally posses good engineering skills. The other problem is one of cost; it's very expensive to train divers to weld underwater.

What industry needs is an effective joining process in which skills and visibility are not primary issues.

One solution is we change the methodology of welding. Most, if not all wet welding is restricted to fillet welds and therefore, simple joint geometry is all that's required.

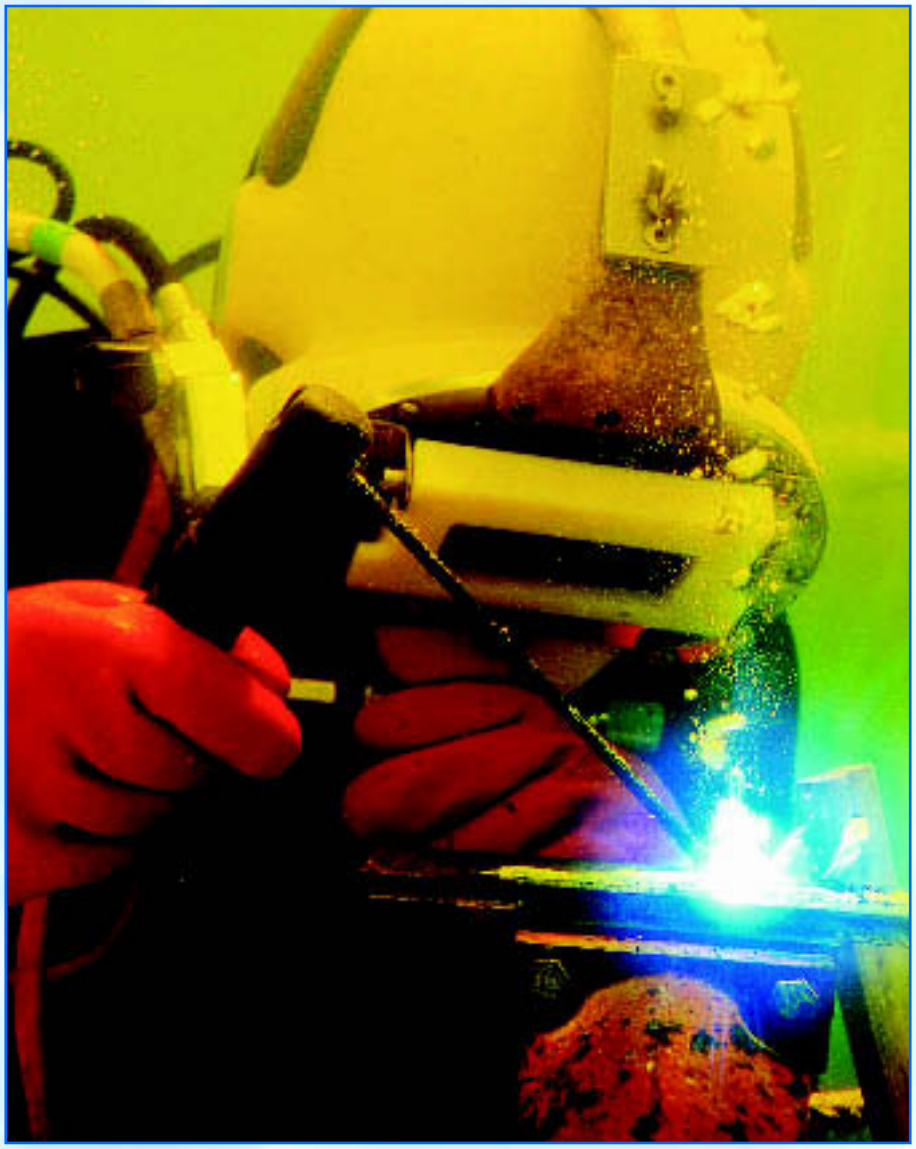
When considering any underwater wet MMA welding application there are a number of considerations, but two in particular are essential:

- **Visibility**
- **Ability**

and it is with theses two that we were recently awarded the DTI SMART Award for our Hammerhead wet-spot system. What we have attempted to do in solving these problems is to provide a MMA method of welding, using standard equipment, in which skill and visibility are simply not required. This has meant a completely different approach to how we make a weld, although the process remains MMA and has close links to 'spot' welding, at least in principle.

The welders amongst you will of course appreciate the skills required to produce a fillet weld.

To make a weld underwater requires considerably more time, energy and expense. We hope our solution will, in many cases, provide a real alternative. The welding parameters (amps/volts/timer) are set by the operator, taking into account the size of the electrode, thickness of material and welding position. Once established, through trial and error, the system is set to automatic and the welding parameters are controlled by the system, not the diver.



All the diver needs to do is to 'push' the electrode through the materials in a linear fashion. The system can also be set to manual so individual parameters can be changed, or modified to suit.

Photo (2) shows a single pass fillet weld I made underwater, welded in the 2F (PB) position, using our 3.2mm Barracuda Gold electrodes. All welds were made on 8.0mm steel plates at a depth of 3M. The actual weld was subjected to a tensile test and the following was recorded; before welding the plates were cleaned by grinding, tacked together and then the weld deposit made. The total weld/preparation time was approximately 4-5 minutes.

D1 wet fillet weld
Dimensions: 10.25 x 81.25mm
CSA: (mm2) = 832.81
UTS: (Mpa) = 325
Load: 270.9kN (weld break)

Photo 2
Shows a single pass wet fillet weld

The following weld was conducted to compare the above with a weld made in air.

A1 dry fillet weld
Dimensions: 7.88 x 82.60mm
CSA: (mm2) = 650.89
UTS: (Mpa) = 403
Load: 262kN (weld break)

Photo 3
Shows a single pass dry fillet weld

If we now compare a wet-spot weld I made on 2 x 8.0mm steel plates, under the same conditions. In making these welds there was no preparation as such, just one plate laid upon another, no cleaning. The weld took approximately 6-7 seconds. Total set-up / welding time, less than 30 seconds.

Photo 4
Shows a single wet spot weld

G2 wet spot weld
Dimensions: 13.61mm approx diameter of weld nugget
CSA: (mm2) = 63.20
UTS: (Mpa) = 668
Load: 42.2kN (weld break)

Just to compare a wet spot to a dry spot the following weld was made in air.

Photo 5
Shows a single dry spot weld

G1 dry spot weld
Dimensions: 22.36mm approx diameter of weld nugget
Examined area: (mm2) = 78.07
UTS: (Mpa) = 587
Load: 45.9kN (weld break)

This information is even more impressive when you consider that the conventional fillet welds were sound defect free welds.

The spot welds by contrast do appear to have inclusion type defects within the weld body and cannot be said to be defect free, but still provide an effective joining means at a fraction of the cost.

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