

Speciality Welds' new system, which has been named Hammerhead in keeping with the company's 'fish' brand, addresses problems in obtaining high quality wet welds in nil visibility, without the need for experienced (skilled) welder-divers.

By removing the individual welding skills from the operation, there's no need for the diver-welder to control parameters that affect quality, such as travel speed, electrode angle, arc length and accurate deposition. Because the operator no longer needs to control these parameters, it is not essential to have good visibility. So, even in nil visibility conditions high quality repeatable welds can be produced time after time.

How the system works

In removing the skills necessary to carry out underwater wet welding, Speciality has modified the fundamental approach to how 'stick' welding is carried out. The company's system allows the operator a far more simplified role.

How is all this achieved? In simple terms, by creating a spot/plug weld rather than having to deposit a fillet weld within a specified joint.

By removing the need for a fillet weld deposit Speciality has also simplified the joint configuration (simple lap joint) and all the preparation that goes with it, while also removing the need for extensive cleaning of the joint area and chipping off metres of

Zero visibility, no skill welding

Speciality Welds, UK, has developed solutions to the long-standing problems associated with underwater wet welding, and in particular the skills needed to produce high quality welds in poor or nil visibility, writes Speciality's David Keats.



Control system housed in standard 400-amp safety switch/control unit.

slag prior to additional passes. In fact there is no need for additional passes as the process is designed as a 'one-shot' approach – ie, one electrode produces one spot/plug weld.

Other than the control system/electrodes, all other equipment is exactly as conventional 'stick' welding. The control unit is connected to

the welding power source via the remote control facility and is powered by 110-volt supply. All welding leads pass through the company's 400 amps Piranha safety switch before going to the diver.

Role of the control unit

The control system manages and manipulates the following:

- A timer
- First peak/high current setting
- Second background/low current setting

The first high current setting allows the electrode to pierce through the materials, thereby creating a hole through which both materials are joined together. The role of the timer is to limit the depth of this penetration, so as to avoid bursting through the base (back) material.

After the first weld cycle is completed and depth of pene-

tration achieved, the second, lower current is automatically initiated and it is this current that fills the hole. This creates a spot/plug weld that has penetrated both sections of material, thereby creating a weld nugget.

During the operation the diver, or indeed robot, need only apply sufficient pressure to the electrode to push it through the material while welding.

The guidelines shown in Table 1 provide basic benchmark settings for selecting current and timer.

The operator can then make any minor adjustments as are seen necessary to ensure adequate weld quality. Presently, only one size of electrode is available – namely 3.2mm (1/8 inch) – but this covers a wide range of material thicknesses.

Weld strength properties

The size of a given weld, and therefore the number of welds required, is based on the following principle (area of a circle with 'd' as the diameter of the weld):

$$\frac{\pi d^2}{4}$$

Therefore, a single spot weld can offer the following strength properties:

$$\text{Max load} = \frac{\pi d^2}{4} \times \text{shear strength}$$

(neglecting any bending moment).

Typically, the shear strength for plain carbon steel is generally assumed to be 4/5 the ultimate tensile ►

3.2mm / 1/8 inch Electrode	Timer	High Current	Low Current
Plate thickness: 8-8mm (16mm) 5/8 inch	4-6 Sec	250-260	150-160
10-10mm (20mm) 3/4 inch	5-8 Sec	260-270	150-170
12-12mm (24mm) 1 inch	7-9 Sec	270-280	160-180

Table 1.

► strength. The Hammerhead electrode offers a tensile strength of 650N/mm² (94ksi) and therefore will offer a shear strength of approximately 520 N/mm² (75ksi). Therefore, a 10.0mm (3/8 inch) diameter weld nugget will produce a max load capability of 40.840 kN (9,181 lb/f) per spot.

The weld strength offers improvements over ferritic steel electrodes and generally the heat-affected zone (HAZ) hardness is improved. The electrodes have a 22.5Cr and 14.45Ni equivalent, thereby

allowing for high percentage dilutions up to 50 per cent.

The spot weld shown (bottom, left) took 40kN to fail and had a total area of 65mm². The UTS was 606 N/mm². Compare this to a defect free single pass fillet weld failing at 259kN, but having a total area of 746mm² with a UTS of 347 N/mm². We see the spot weld offers nearly twice the strength capability.

Conclusions

The process clearly remains a manual welding operation and is not defect free. Trials were limited to flat bar/plate stock welded in the flat and vertical positions.

However, the welding skills necessary for a diver to produce a weld have been removed, as have much of the material preparations and need for good visibility. Of course, there is a period in which the operator will need to familiarise himself with the



The Hammerhead system has the added advantage of also working well for welding above water.



Image shows a spot weld and 'flash' test piece cut through the centre and macro polished.

process, but this can be achieved in a very short period. A good diver would be expected to produce an acceptable weld within a matter of minutes rather than hours, or days.

The process does offer solutions to welding in poor visibility, without the need for skilled welders. So all in all, Speciality believes this

process offers a serious alternative to this long-standing problem.

As an added bonus, the system also works extremely well for welding above water.

● Details – A full and detailed report on Hammerhead is available to download from Specialty Welds' website at www.specialwelds.com