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Journal of the Southern African Institute of Welding



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African Fusion talks to members of Air Liquide's Welding and Cutting team about the effects of welding fumes, the influence of shielding gas, welding process choices, safety knowledge and practices.

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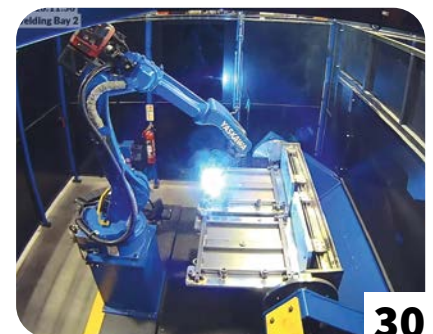
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Having spent the previous few years securing the SAIW's stability and financial sustainability, last year we started to focus on improving customer experience. This we have carried forward as a key focus for 2024 and I am very pleased to be able to share some results with you.

I am particularly pleased with the feedback received from our ISO 3834 clients in the 2023 survey. The SurveyMonkey® customer service experience index for ISO 3834 returned a net score of 95%, which is well into 'very positive' territory – the global benchmark for this level being 74%. In addition, 99% of our ISO 3834 clients declared that they were 'very satisfied' with the audits carried out by the SAIW, so we feel we are continuing to do very well on the company certification side.

Further supporting this view, the recent IIW Annual Congress and International Conference in Greece rated the SAIW second only to Italy in terms of the number of ISO 3834 certifications issued through the year, while the IIW's Certification auditor rated our Fabricator Certification scheme as the best run ISO 3834 system in the world.

This makes me very proud. All our certified fabrication companies in South Africa can take this as further evidence that our welding industry can be globally competitive with respect to weld quality.

A second area we surveyed was our Laboratory service, which we sent to everyone who has used this SAIW service. Customer satisfaction levels are also very good here and our customer base is continuing to grow.

The real reason for doing these surveys, though, is to find out how we can improve. In this regard we have had good feedback for our Level 1 and Level 2 Inspection Course programmes. We have long been aware of the need to improve our pass rates, particularly for these two Inspection courses. We have now made changes in response.

As a condition of entry to the Inspection course programme, we used to ask for a Matric pass certificate in either science or mathematics. But a pass requires only 30%, and we found that many students entering the Level 1 course could not handle the theoretical side of inspection and, with the heavy workload involved, would quickly fall behind.

Now, to have direct access to Level I courses, students must have a 50% pass in both mathematics and physical science. However, for those whose matric results are not high enough, we have introduced a new course called 'An Introduction to Inspection' which offers an alternative route.

This two week, ½ price course consists of a full week recapping the maths and science required for success, followed by a further week where students are introduced to the terminologies, processes and typical defects they will be dealing with during the follow-on courses. So, students with marginal matric results get an extra few weeks to come to grips with weld inspection before making the bigger investment in the full course. Also, through future discounts on the Level 1 course, this course becomes free for those who manage to pass and carry on.

In addition, since there is no great demand in South Africa for the IIW International Welding Inspection (IWI) diploma, we are looking at revising the syllabus to focus on meeting our local industry's needs. This will be taken to our SAIW Board for approval at its next meeting in August.

Furthermore, the IIW has agreed that, once a student has successfully completed both Level 1 and Level 2 exams, they may write the harmonised, multiple-choice IIW IWI Basic exam. Then, following two years of in-service experience, and some preparation courses that we will develop, they can write the IIW IWI Standard exam. With this combination of prior learning, experience and supplementary IIW examinations, the IIW International Inspector diploma will still be accessible to anyone who has successfully gone through the SAIW's Inspection Programme.

Thanks to all of you who responded to the surveys. They really do help us to continually adapt and improve.

John Tarboton

Optimising welding fume generation without comprising safety and weld quality

Africa Fusion talks to members of Air Liquide's Welding and Cutting team about the effects of welding fumes, the influence of shielding gas and welding process choices, safety knowledge and practices leading to quality welding results.

Within Air Liquide, there is a network of Welding and Cutting experts collaborating on topics that impact welding industry applications and technologies. The teams cooperate to resolve pressing and technical issues in their respective markets and on a global scale in the domains of welding and cutting, including welding fumes, safety and weld quality, among others. In Africa, and particularly in South Africa, the risks associated with welding fumes are not generally prioritised by welders and welding coordination teams due to factors such as insufficient knowledge on the topic and a lack of resources.

There are common misconceptions about safeguarding risks in the absence of PPE, such as drinking milk after a shift to flush the inhaled particulates. There are also fears of the harm that can result from prolonged exposure, including infertility resulting from inhaling fumes generated from welding. These observations have created a sense of urgency to educate welders on the correct mitigation of welding fumes, especially in emerging markets. "Indeed, the risks are not being sufficiently highlighted and understood, particularly by the people at the end of welding torches, that is, the welders themselves," confirms Mwali Kawawa, Air Liquide's Business Developer based in South Africa.

The International Agency for Research on Cancer (IARC) has classified welding fumes as carcinogenic^[1], bringing to focus the urgency to find ways to mitigate against risks associated with welding fumes and choosing the right behaviours to keep welders as safe as possible. "Simply put, lower fume generation reduces risks, making

welding a safer, more ergonomic and a less stressful occupation for welders," Mwali elaborates before handing over to Ehsan Khan, Air Liquide's Welding and Cutting Expert based in India, to explain further.

"A well-designed exhaust system is paramount to avoid welder exposure to fumes. Shielding gases do not generate welding fumes, but a good choice of gas can contribute to decreased fume emissions by stabilising the process," explains Khan.

Fume risks and shielding gas

Highlighting the fume exposure risk, Khan describes the typical breathing capacity or tidal volume of a person as, on average, ½ litre of air per breath. At a breathing rate of 16 breaths per minute this equates to 8 litres of air every minute. "If you work shifts of eight hours for 250 days a year, you are breathing 2 000 m³ of potentially contaminated air every year," he says^[2].

While the particle concentration in the welding fume is approximately 5,0 mg/m³, in this case the exposure to solid particles would be 10 000 mg or 10 g per year. "When the base metal is clean, approximately 90% of the fumes are generated by filler metal only. It is, therefore, very important to ensure that the welder's environment is controlled and designed to have minimum fume generation," Khan points out.

The welding fumes that form as the by-products of all arc-welding processes consist of solid particles. Their formation cannot be avoided, but their emission rate can be reduced by optimising the welding process parameters and the correct selection of consumables.

Michael Schmitz, Air Liquide's Applica-

tion Engineer based in Germany, goes on to describe the mechanism of particle formation: "The high temperature of the arc first results in the formation of metallic vapours. As these move away from the arc the vapours react with oxygen in the environment as it cools and gets condensed to form oxide particles," he says, adding that the elemental content of a specific metal in the fume will depend on the boiling point of the constituents in the filler wire and base metal.

For mild steel welding, the main compounds found in welding fumes include spinel oxides (Fe₃-xM_xO₄, where M=Ca, Ti, Ni, Mn, Cr, Cu, etc); amorphous silicates (SiO₂); and, when welding using consumables with basic fluxes, fluoride compounds.

Stainless steel welding fumes consist of all the fume compounds associated with mild steels, with the added danger of hexavalent chromium (VI), a carcinogen: Cr (VI) is potentially present in stainless steel welding fumes depending on the consumable. While fumes from aluminium alloys can contain alumina (Al₂O₃), amorphous silicates and Al-Mg alloys (MgAl₂O₄).

Schmitz describes two broad size ranges for these particles. The larger aggregates, of a few hundred microns, can be filtered out if breathing through the nose or if the welder is using a face mask. The main issue is with the 'respirable dust', which can be classified in two categories as follows:

- Respirable fraction below 10 microns.
- Ultrafine particles below 0.1 microns)

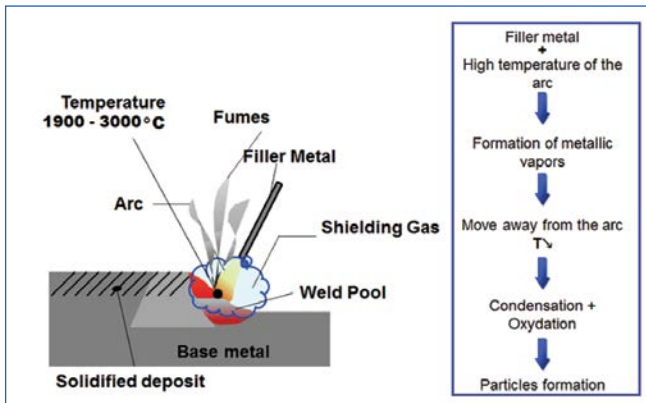
GMAW welding trials to minimise fume production

Laboratory tests were conducted according to the ISO 15011-1 standard to compare fume emission rates for different gas metal arc welding processes of mild steel options under laboratory conditions. Schmitz says that parameters were set for each GMAW metal transfer mode – short-arc, globular, and spray – with the wire feed speed left unchanged when changing between the four chosen shielding gases. For each trial, the fume emission rate (FER) was measured in mg/s per unit (g/kg) of weld metal deposited.

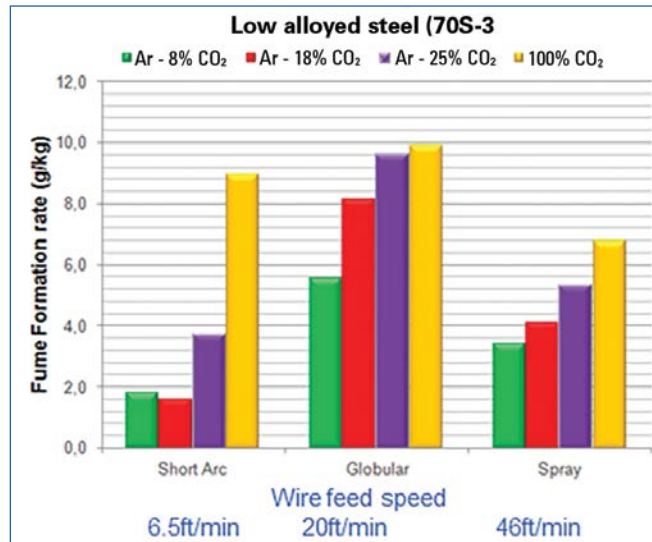
"Results suggested that the fume emission rate (FER) is significantly affected by the metal transfer mode used. It increases with the wire feed rate for conventional metal transfer, but the pulsed welding mode with cleaner metal transfer reduces the FER, while in globular metal transfer mode, the



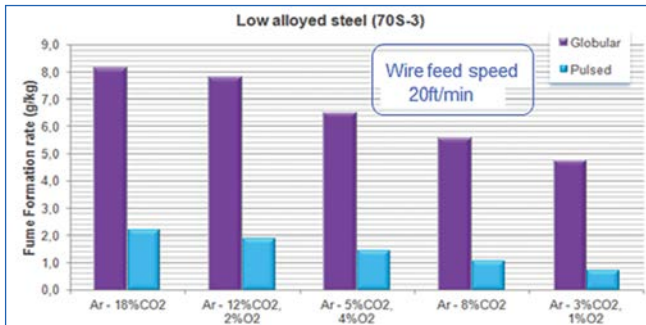
A comparison of the fume generated while welding with Air Liquide's ARCAL™ 14 (left) and ARCAL™ Force (right).



The mechanism of particle formation: Metallic vapours are first formed. These react with oxygen in the environment as they move away from the arc, and then condense to form oxide particles as they cool.



The study showed that the FER increases with the CO₂ percentage in the shielding gas for all transfer modes.



For the same deposition rate, pulsed mode results in a much lower FER than globular transfer mode.

FER is much higher per unit of metal deposited,” he notes.

In terms of the influence of the shielding gas choice, the FER increases with the CO₂ percentage in the gas. While a little CO₂ is needed to ensure arc stability, increasing the CO₂ percentage leads to an increase of the oxidation energy, which can lead to more fume formation, he explains. The comparison between globular transfer and pulsed transfer welding is notable, where for the same deposition rate, pulsed mode results in a much lower FER. “The lower heat input of pulsed mode with one droplet detached for each pulse delivers a cleaner weld with very low spatter levels and far lower fume emissions” Schmitz notes.

“A GMAW welder using pure CO₂ as the shielding gas experiences more instability, more spatter and a hotter weld pool, all of which, as the studies show, result in higher levels of metallic particles and oxides in the fume,” continues Khan.

“Using pure CO₂, the fume generation rate was found to be 0.74 g/min of welding. When it was measured using the ARCAL™ Speed shielding gas, the generation rate was reduced to 0.19 g/min – a 74%

reduction, simply by changing the shielding gas mixture,” says Khan.

Furthermore, Air Liquide offers an optimised shielding gas mixture for GMAW welding of steels that would meet the weld quality and fusion standards required while producing minimal quantity of welding fume. “ARCAL™ 14, is a three part gas mixture that has less CO₂ content and aids in improving the fluidity of the weld pool. ARCAL™14 delivers a stable welding arc and a further reduction in the FER,” Ehsan Khan tells *African Fusion*.

Safety first

Ever present risks of fume inhalation include lung and throat irritations that can quickly lead to infections such as asthma, pneumonia and other respiratory diseases. However, medical studies have also reported an increase in the cancer risk for welders.

Precautions need to be taken to minimise fume emissions as much as possible. To protect welders, the people in their surroundings and to fulfil national regulations, well designed extraction systems are required. “A careful selection of the welding process, materials to be welded and shielding gas can help to minimise the emission of welding fumes and improve safety,” notes Kawawa.

In summary, Kawawa notes the four ways in which the risk of welding fume can be substantially reduced:

- Training and awareness are at the starting point. Welders must be conscious of the serious health risks associated with the welding fumes.
- Attention to the welding process choices and parameters that deliver the best welding stability and lowest spatter and fume emissions levels will also help.
- In order to comply with local regulations, the use of appropriate fume extraction, respiration equipment and welder’s protective equipment should always be considered.
- And finally, the choice of shielding gas matters.

“At Air Liquide South Africa, we are here to help. From a welding perspective, the gas choice is our first priority. In addition, we are happy to help fabricators to optimise any aspect of their process so as to minimise the fume risk to welders,” Mwali Kawawa concludes.

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	OEL: 8 hr				
	CO ₂ (ppm)	CO (ppm)	NO (ppm)	NO ₂	Particles (mg/m ³)
OSHA	5 000	50	25	5.0*	Respirable fraction: Fe: 10 Al: 5.0 Ni: 1.0 Mn: 0.2
NIOSH	5 000	35	25	1.0*	Fe: 5.0 Mn: 1.0 Ni: 0.015
ACGIH	none	none	25	0.2	Welding fumes: 5.0 Fe: 5.0 Mn: 0.02
India		55			Mn: 1.0
South Africa	10 000	50 30 (mining)	50 25 (mining)	0.4 3.0 (mining)	Welding fumes: 5.0 Fe oxides: 10 Mn: 1.0 (mining)

*15 minutes average value, no 8 hr value

Figure 1: Occupational Exposure Limits OSHA/NIOSH/ACGIH/India/South Africa.

References

- [1] IARC Monograph, 2018, Vol. pp 118.
- [2] This is an ideal case scenario. Actual exposure is much higher in developing countries such as India and SA. Practical experiences shows particulate exposure can reach up to 100 gm/yr.



NDT Centre of Excellence for the nuclear industry

With funding from the IAEA (International Atomic Energy Association) and in partnership with NECSA (South African Nuclear Energy Corporation), the SAIW is leading a technical cooperation project to establish an NDT centre of excellence for the nuclear industry at NECSA's Pelindaba nuclear research facility. *African Fusion* talks to the SAIW's Mark Digby and Harold Jansen about the initiative.

With a special focus on ultrasonic phased array testing (PAUT) and time of flight diffraction testing (TOFD) – both of which are seen as advanced NDT techniques, ideally suited to the critical needs of the nuclear power industry – NECSA and the SAIW, with funding from the IAEA, are partnering to establish a centre of excellence for NDT to advance South Africa's national capability.

"The lack of PAUT (phased array UT) and TOFD (Time-of-flight diffraction) capabilities in South Africa, particularly those focusing on the specific needs of the nuclear sector, has resulted in traditional NDT capabilities being adopted in the nuclear sector, which limit detection success," begins Harold Jansen, the Certification and Qualifications manager for the SAIW.

Also, though, he points out that the number of South African women involved in NDT has been low, with only 13.5% representation since 1980. "Statistics taken from the start of 2021 to 2024 show a drastic improvement in these number with 27% of all new NDT students now being

female. As a core outcome of this project, the IAEA has asked us to focus specifically on increasing the numbers of women at the highest levels of the NDT profession, so the initial programme is seeking at least 10 and up to 16 women to train up to 'Level 2+' on these advanced NDT techniques. That means they need to have completed Level 1 and Level 2 NDT qualifications before starting PAUT and TOFD courses at LEVEL 2 – and, for nuclear, beyond Level 2," Jansen explains.

Phased array and time of flight diffraction

Explaining why PAUT and TOFD have been selected for special attention within the NECSA Centre of Excellence for NDT, Mark Digby, the SAIW's Training Manager says these are both advanced NDT techniques that overcome many of the shortcomings of traditional ultrasonic testing (UT).

With traditional UT, he explains, an ultrasonic signal generator and receiver box with an oscilloscope-type display is used to send and receive ultrasound signals via a



Phased array UT uses a probe with 64 or 128 separate transducer elements to enable every probe angle to be covered at the same time, which enables the whole weld profile to be tested at the same time.

probe. "There are probes with different angles – 45°, 60°, 70° and 90° probes, amongst others – for seeing different areas around a weld. The testing process is very much operator dependent. The right probe angle needs to be selected for each inspection area, and the operator needs to manually interpret the return signal and write down what he sees on the scope," Digby explains.

Phased array UT, he says, uses a probe with 64 or 128 separate transducer elements, which can each send signals and receive signals. "The combination of all these elements into a single probe that is only 2.0 to 3.0 cm long enables every probe angle to be covered at the same time, so the whole weld profile can be tested without having to change probes. And every angle is included, which removes the risk of missing a flaw because the NDT technician did not have a probe with exactly the right target direction," he says.

Also, though, the encoded data is processed by the PAUT instrument so the operator can see the area being scanned



A view of NECSA's Pelindaba nuclear research facility in South Africa, where the SAIW is leading a technical cooperation project to establish an NDT centre of excellence for the nuclear industry. Photo by NJR ZA: Own work, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=2871304>



The Koeberg Nuclear Power Plant near Melkbosstrand in the Western Cape of South Africa. According to the IAEA, a third of the countries of the world currently considering nuclear power are in Africa. Egypt, Ghana, Kenya, Morocco, Niger, Nigeria and Sudan have already engaged with the IAEA to assess their readiness, while Algeria, Tunisia, Uganda and Zambia are also looking.

and any flaws that might be present. And there is a vast amount more data to ensure nothing is missed, data that can be saved and relooked at in more detail at a later stage, several years later when the same test needs to be done again, for example,” Digby tells *African Fusion*.

Highlighting the key role of TOFD within the nuclear industry, he says there has long been a demand for a flaw sizing tool that can be used to record and track whether or not an acceptably-sized flaw has seen any significant change. “Time of flight testing gives us this opportunity. The process is very good at sizing in all directions. Let’s say there is a small but acceptable inclusion in a weld, we will then need to know when this inclusion starts propagating a significant crack. We therefore regularly need to check the exact sizes of the original defect to ensure it is not going to become dangerous.

“So, TOFD is ideal for use as an in-service NDT technique to monitor the exact size of known defects. While most methods can give us an accurate measure of the length of a flaw, TOFD can highlight the exact length, width and height of that flaw. And, like PAUT, it also produces digital data that can be saved and recalled for comparative purposes at every follow up inspection,” notes Digby.

NDT personnel in South Africa, he continues, have been doing in-service NDT at Koeberg and on NECSA’s Safari reactor for many years, Koeberg has probably been tested maybe 10 times in the last so many years. So staff there are aware of exactly

what the welds were like at installation and how they have changed between each inspection interval. But this is often down to a specific operator using a specific UT machine, a specific probe, and a specific cable. When an operator leaves, though, he or she can leave a very big knowledge hole.

“TOFD can help, because it is much easier to collect the data and that data is automatically stored and referenced for later retrieval and comparison,” Digby says.

Sounding a warning note, he mentions that better NDT techniques, such as phased array UT and TOFD, can be unpopular because they find flaws that would not previously be seen. “Some people argue that finding too much is a problem. But it is not as if these flaws were not there before, it is just that we were not able to find them. It is better to know exactly where all the flaws are, and also to size them properly so we can reliably determine exactly how critical each of them is,” Mark Digby advises.

Next steps

Turning attention back to the NDT Centre of Excellence for the nuclear industry, Harold Jansen says the intention is to send out invitations to the Top 10 NDT service providers in South Africa to find the highest qualified black and female NDT professionals to make up the first cohort of trainees. “The course will not be free, but it will be heavily subsidised – the SAIW will only be recovering its basic costs – so for a course at this level, it will be a great opportunity for the professional women and for the companies in which they work,” adds Jansen.

The equipment needed for the training course has already been ordered, also via local NDT service providers. “We at SAIW appreciate the fact that local procurement of equipment is best practice, both to support the local industry and because it comes with after sales service; the equipment is known to the NDT industry; and providers can also offer training capabilities. South Africa needs a local platform for nuclear-focused research and development, so it is essential to enhance the quality of education, training and competence of NDT personnel and companies, and to feed that competence back into existing training programmes,” he says.

Global specialists in PAUT and TOFD have been approached to deliver the training programme, and current expectations are that the first three sessions will take place between September and November this year.

“Since 2000, the SAIW has been involved in Level 1, Level 2 and Level 3 NDT training, qualification and certification for more than 160 AFRA fellows from 17 different countries. This portfolio of evidence is testimony that the proposed project with this strategic partnership will ultimately benefit and support the current Nuclear Industry and the envisaged new Nuclear Build Expansion Programme. “This is imperative for the development of the safe performance and reliable operations of nuclear and other equipment, structures and plants within South African industry,” Jansen concludes.

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BHI: world-class heavy fabrication for all OEMs

African Fusion visits the Richard’s Bay manufacturing facility of Bell Heavy Industries (BHI) and talks to Henk de Villiers, the company’s production manager and ISO 3834 Welding Coordinator, about the extended customised heavy fabrication offering now available, not only for OEMs of South Africa’s mining, construction and agricultural equipment fleets, but for all heavy fabrication requirements in the Southern African region.

Bell Heavy Industries is a newly formed company that is wholly owned by Bell Equipment, the South African-born global OEM of Bell ADTs for the mining industry and a host of other specialised equipment for the construction and agricultural sectors. This flagship manufacturer has been designing and manufacturing the Bell brand of machines in South Africa for many years and exporting them from Richards Bay to destinations all over the world, Henk de Villiers points out.

In recent years, however, Bell Equipment has been expanding its European manufacturing hub in Germany to reduce Richards Bay’s import and export logistics for machines destined for sale in the European and USA markets. Moving more of the manufacture of the highly successful Bell ADT range to Europe, explains De Villiers, has freed-up capacity in Richards Bay.

“We now have the opportunity to offer customised heavy fabrication for any other equipment brand or any heavy fabrication requirements; hence the new company, BHI, which is not restricted to manufacturing for Bell-branded machines. BHI can offer heavy fabrication expertise to all local

equipment distributors, suppliers or users of any OEM’s equipment,” he says.

He adds that Bell Equipment has long been customising and manufacturing optional low-density bins for existing and new trucks, along with water tanks to expand the Bell Versatruck offering and repurpose used Bell ADTs. “We have also been manufacturing new buckets for Kobelco excavators and JCB machines, for delivery to customers through our local Bell Equipment distribution network,” he adds. BHI, therefore, fits very comfortably into Bell Equipment’s existing fabrication facility in Richards Bay.

ISO 3834 certification

“We are a globally competitive company that manufactures to world-class quality standards and being an ISO 9001-2015 accredited company is a given. In terms of welding for our own OEM equipment, we are obligated to work under the strict quality control measures, typically AWS D14.3, the American National Standard for welding earthmoving, construction and agricultural equipment,” says Henk de Villiers, adding that complying with this standard is essential for exporting earth-



moving vehicles into Europe and the US. The offering is not limited to this standard and, with certification in place, BHI has the expertise and equipment to handle most structural, sheet metal and low-pressure piping systems.

When asked why BHI has adopted ISO 3834 certification, he responds that while ISO 3834 was never a core requirement for internal OEM components for Bell Equipment: “It is necessary to assure external customers, including other OEMs and end users, that all our quality systems, procedures and welding process controls are perfectly aligned with ISO 3834. So, we have now been officially audited by Herman Potgieter from the Southern African Institute of Welding (SAIW) for certification to ISO 3834-Pt 2, the comprehensive quality requirements for this welding standard,” De Villiers responds.

He mentions though that everything necessary for accreditation was already in place, as Bell had aligned itself to these standards years ago.

“In principle, our local customers need to know that all the welding on their products is done under fully controlled conditions: the materials and consumables are correct, the welding procedure is approved and consistently adhered to, and the post weld inspection shows that the welds meet the requirements. So, BHI can now say that any product a customer asks us to manufacture will meet all weld quality requirements of AWS D14.3, or most other requested standards under the direct guidance of ISO 3834-Pt 2.

Niche welding expertise

In South Africa, there are not too many other companies that can fabricate the large and complex components needed for heavy equipment, De Villiers continues. “Our facility is equipped with numerous 10 t cranes, each with an 6,2 m clearance, which enables us to accommodate several large fabrications simultaneously,” he says.



Most of the welding at BHI is done using the down hand (1G, 1F and 2F) positions, where solid wire, gas metal arc welding (GMAW) is preferred.



On the skills side, he emphasises that the company has over 400 welding machines and operators, working multiple shifts. All are recruited locally and every one of them is trained in-house. “On the welding side, we employ skilled, semi-skilled and novice welders. We recruit people with the basic knowledge of the welding processes and test their hand-eye coordination and basic welding skills.

All new welders are put through a formal 12-week training course on the specific applications we need them for. And before they are asked to do any production welding work, they are coded on the processes and procedures they will need to use,” De Villiers informs African Fusion.

A qualified in-house welding inspector formally assesses the welders, based on the test sample/coupon produced. “If a customer requires us to code welders working on their jobs, signed off by an Authorised Inspection Authority (AIA), BHI will be happy to comply. At the end of the day, though, training and coding are the duty and responsibility of the manufacturer. It is up to us to assure our customers that our welding personnel, and the procedures we use, meet the agreed welding standard and ISO 3834 requirements,” he says.

In terms of processes, he explains that most of the welding at BHI is done using the down hand (1G, 1F and 2F) positions, where solid wire, gas metal arc welding (GMAW) is preferred. “We also use flux-cored arc welding for out of position application. If welding in the gravity position, nothing can beat solid wire GMAW in terms of costs, but to weld in the horizontal, vertical up or overhead positions – 2G, 3G or 4G – higher deposition rates and better fusion can be achieved with flux-cored wires, because a hotter weld pool can be supported by the fast-freezing slag from the flux,” he explains.

Bell Equipment also has a very limited need for shielded metal arc welding (SMAW), mostly applied where special consumables are needed, such as for some welding on hydraulic cylinders, for example, he adds.

Most notably for hydraulic cylinders, though, he says, Bell has implemented and perfected the friction welding technique to join the hydraulic pistons and rod ends to the chrome-plated push-rod material. “There are not too many fabricators with a friction welding capability. We have developed our own tooling design for this machine that includes all the clamps, jaws, hydraulics, and electronic controls,” he says.



BHI can offer heavy fabrication expertise to all local equipment distributors, suppliers or users of any OEM's equipment.

Another key feature of friction welding for this application is that no added consumable is needed. The fully fused weld is very narrow and neat and very little of the chrome plating is affected. “We seldom need to do more than clean out expelled dross. Also key to successful friction welding of this material is slow cooling after welding, which Bell does by simply covering the finished welds with an insulating material in a ‘bead bath;” De Villiers explains.

Secure consumable supply

In support of Bell Equipment’s ongoing fabrication needs for its local distribution network and customers, along with the new BHI needs, a dedicated consumable supply agreement has been struck with ESAB South Africa. ESAB has now established a dedicated warehouse for the daily supply of welding consumables into Bell and BHI’s Richard’s Bay fabrication facilities. For solid wire GMAW, the facility has standardised on ESAB OK Aristorod 12.50, which is a copper-free solid wire that has been treated with ESAB’s Advanced Surface Characteristics (ASC) process to reduce post weld cleaning requirements, which was a “key differentiator” for De Villiers.

And for flux-cored welding, the Dual Shield 7100 Ultra wire has been chosen, a high strength wire developed specifically for out of position welding.

“For us, the key benefit of this warehouse is that, as part of our ISO 3834 certification, we must show that all the consumables we use are being properly stored and controlled. I can now take a customer or an auditor to a warehouse across the road and show them how our consumables are being kept, managed, and controlled.”

Also, he continues, Bell/BHI does not have to keep large stocks of consumables. “We take deliveries of what we need every day, and the warehouse always keeps at least two months’ worth of stock on hand.



Robot welders and manipulators are typically used for long-section welding where surface finish is important.

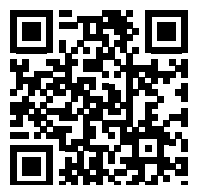
We just call off that stock at a rate of between one and two tons every day, 40 to 50 t per month,” he explains.

Global expertise for local needs

Underpinned by Bell Equipment’s fabrication experience for global markets, BHI has all the welding processes and expertise, including robot welders and manipulators; laser, plasma and flame cutting equipment; and heavy plate rollers, boring mills, and large machining centres to deliver complex heavy fabrications to meet any local need.

“For anyone needing a special machine for earthmoving, construction, military or agricultural use; a bucket, bin or water tank for a vehicle; or any heavy steel structure that might be too big or too complex to manufacture in a conventional fabrication shop, we are willing and ready to help,” he concludes.

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SAIW enhances nuclear standards in Africa

The recent announcement that South Africa's Energy Minister Kgosientsho Ramokgopa will unveil details of a new 2 500 MW nuclear power plant by August 2024, means skills and safety standards around South Africa's nuclear industry are more important than ever.

In line with this, the SAIW is powering ahead with its collaboration with the IAEA and Necsa. Facilitated by the Department of Energy, this initiative is in the process of establishing a Nuclear School of Excellence within the Necsa Learning Academy to introduce advanced welding and inspection skills to bolster the continent's nuclear sector.

The School of Excellence is scheduled to commence in the first half of 2025 and will offer a range of specialised courses focusing on welding and non-destructive testing (NDT) for the nuclear sector, nuclear safety, precision measurement and consultancy services.

SAIW Personnel Qualification Certification Manager, Harold Jansen explains: "Precision in the nuclear field is a non-negotiable and accuracy down to microns is crucial for safety and operational efficiency

since minor inaccuracies can lead to significant issues. Our goal is to ensure that professionals are equipped with the necessary skills to maintain the highest safety standards."

Necsa Learning Academy Manager Clive Mokoena also emphasises the strategic importance of the School of Excellence, as it will ensure a continuous supply and development of the much needed Nuclear Skills for the 2.5 GW nuclear power plant and the multipurpose research reactor being planned for South Africa.

One of the key training techniques to be introduced is Time of Flight Diffraction (TOFD), an ultrasonic method that provides exceptional accuracy for inspecting plate and pipe welds. This technique, along with phased array training, will be formally introduced in South Africa, with Level 1 and 2 courses led by industry specialists such as Colin Bird, Ray Turner and Neil Harrap.

"We are committed to making these advanced training techniques accessible, and the IAEA sponsored national project allows these courses to be presented at no



Facilitated by the Department of Energy, the SAIW is powering ahead with its collaboration with the IAEA and Necsa to establishing a Nuclear School of Excellence within the Necsa Learning Academy.

cost to the students – apart from logistical expenses related to travel and accommodation. Since space is limited, only the ten best applicants can be accommodated during 2024 for either the Level 1 UT PA/ToFD or the Level 2 UT PA/ToFD courses," notes Jansen.

This collaboration between NECSA and SAIW will also target female participants holding UT Level 1 or Level 2 ISO 9712 certification in ultrasonic testing with the opportunity for unsuccessful applicants to consider a second intake scheduled for 2025.

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SAIW to introduce laser welding training

The SAIW is set to revolutionise the local manufacturing sector with the introduction of laser welding training. This initiative stems from the increasing popularity of laser welding over the past three years, with fabricators and manufacturers realising the benefits of this value-adding alternative to conventional welding.

SAIW Technical and Practical Welding Manager, Confidence Lekoane, explains, "This initiative is in response to the growing interest in laser welding technology amongst our members, particularly to avoid the costs associated with distortion when welding thin-gauge material using conventional welding equipment.

"The market needs qualified laser welders, and the SAIW has the facilities to provide the necessary training. Therefore, we plan to run the laser welding course to enable both employed and unemployed individuals to become qualified laser welders. The course can also be tailored to accommodate welders in other industries as demand grows."

To ensure it provides the latest laser equipment, the SAIW is in talks with various industry experts and suppliers, including

Factory Smart. Key Accounts Manager John-Owen Welgemoed outlines the advantages of this emerging technology in welding circles: "Laser welding technology has the potential to revolutionise engineering applications as it is an inexpensive alternative to conventional welding techniques.

"Other benefits of laser welding include neater, safer, and faster production at a reduced cost. Additionally, local small businesses could benefit from this cost-effective, easy-to-use, portable, and single-phase power, plug-in system that allows welding anywhere."

Laser welding also provides a cooler and cleaner weld and allows operators to weld three to four times faster than with MIG or TIG processes. The heat-affected zone is much smaller, resulting in little to no distortion.

In addition, there is far less splatter and fume, and the radiation output is far lower compared to MIG or TIG welding, making it safer to operate. Accuracy and strength are also enhanced, as the laser method achieves a good, clean and smooth weld, 99% of the time, reducing the need for refinishing, such as grinding and polishing.

Laser welds are also exceptionally strong, as the laser beam safely penetrates deep into the welded product, giving the welder more control since the line of sight is not obstructed by the full-face mask typically needed for protection against arc eyes and harmful fumes.

To further aid with the development of this technology, the SAIW is in discussions to host an in-depth laser welding seminar in association with the Southern African Stainless Steel Development Association (Sassda) and other industry experts later this year.

training@saiw.co.za



SAIW is set to revolutionise the local manufacturing sector with the introduction of laser welding training.

An overview of the state-of-the-art development of welding and joining technology

This paper, delivered by Tomoyuki Ueyama of OTC in Japan as the Portevin Lecture at IIW 2023 in Singapore, reviews technology targeting carbon neutrality, including: a low heat input and low spatter GMAW process; a laser-arc hybrid process; high-current buried-arc GMAW; and cold spot joining.

Soon after World War II, Japan's welding technology was said to be more than 30 years behind that of Europe and the United States. However, as a result of the efforts of welding researchers and engineers in Japan, the country became a world leader in welding technology in the 1970s and 1980s, following rapid economic growth.

In addition, progress was made in developing power electronics and microprocessors in the arc welding field. As a result, welding processes and their systems were developed to improve welding productivity and quality, including heat input control and spatter reduction^[1,2].

Technological development in the welding and joining fields is being undertaken underpinned by carbon neutrality, a global social issue, along with eliminating labour shortages due to the declining birthrates and aging populations. With this perspective, this paper introduces the status of welding and joining technology development in Japan from a process perspective.

Gas metal arc welding processes

Spatter Reduction

The leading cause of spatter generated during GMA welding is

the expulsion of molten droplets from the molten pool and wire tip. This occurs when the welding arc re-ignites arcs after a high short-circuit current is energized during short-circuit conditions.

Therefore, to avoid this phenomenon, current waveform control^[3] and wire feed/current waveform synchronisation control^[4] have been developed to suppress the expulsion phenomenon by rapidly reducing the short-circuit current just before re-arc from a short circuit occurs, thereby suppressing spatter generation – as shown in Figures 1 and 2.

However, although these processes were effective in reducing spatter at welding currents in the short-circuit transfer region of 180 A or less, they were less effective in reducing spatter at welding currents in the globule transfer region exceeding 180 A (200 to 300 A), which is applied for welded structures of medium and thick steel plates.

As shown in Figure 3, by superimposing a triangular wave in the initial stage of arc re-ignition after a short circuit, the wire fed at high speed can be efficiently melted with a high peak current, and the repelled force can be effectively reduced with a low peak

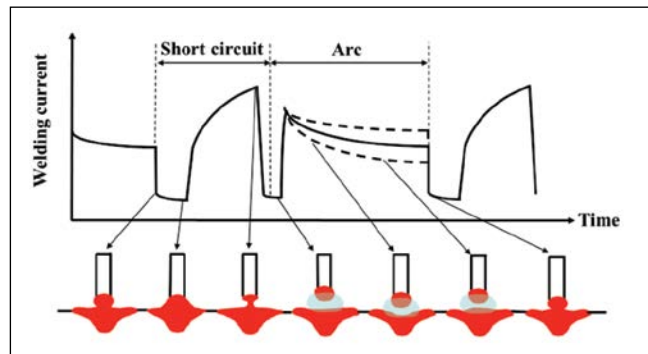


Figure 1: Controlled Bridge Transfer (CBT) Process.

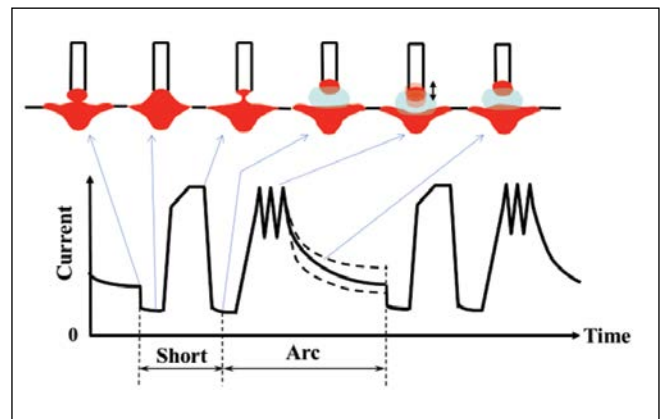


Figure 3: CBT-Expanded process.

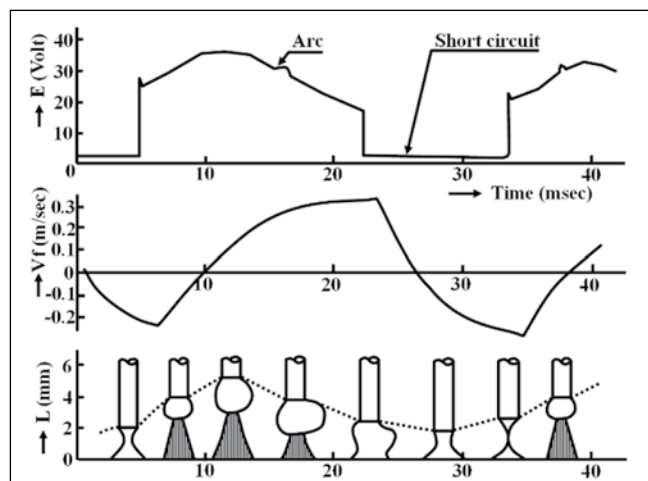


Figure 2: Schematic of wire feed control with arc phenomena.

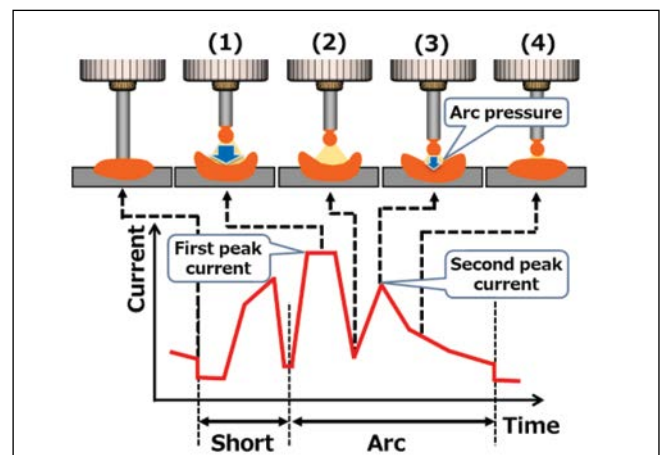


Figure 4: New current waveform suppress repelled transfer and instantaneous short-circuiting.

current, consequently stable droplets can be obtained to improve low spatter performance^[5].

The other waveform control that has been developed is shown in Figure 4. After the first peak current is output, the current is rapidly reduced to prevent repelled transfer at arc reignition as shown in Figure 4 (1)-(2). After that, the secondary peak current is also output to suppress instantaneous short circuiting between droplet at wire tip and molten pool – Figure 4 (3)-(4)^[6]. In both cases, spatter generation at the time of reignition is suppressed by causing large molten droplets on the welding wire tip to dip into the molten pool in a periodic cycle aligned with the wire axis.

A 100% CO₂ GMAW process has also been developed to control metal transfer in free flight without short-circuiting while moving the wire feed direction forward or backward^[7]. Figure 5 shows a diagram of wire feed and current waveforms, along with metal transfer. For example, in Figure 5a-b, the droplets move toward the molten pool with acceleration by advancing the wire while forming droplets at the wire tip. As a result, when the wire feed direction is reversed backward, as in Figure 5c, the droplet at the wire tip moves toward the molten pool due to inertia, resulting in a wedge above the droplet (Figure 5d) and the droplet detaching without a short circuiting (Figure 5e).

In this case, if the welding current at the time of droplet detachment can be controlled to a low current of about several tens of amperes, spatter generation at droplet detachment can be suppressed.

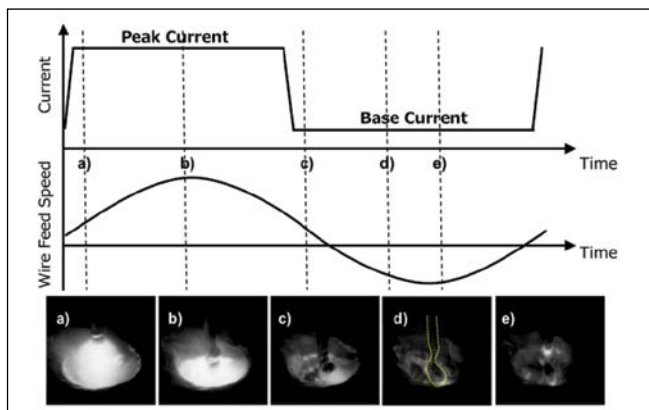


Figure 5: Droplet transfer phenomenon using inertia in the developed process.

High efficiency and productivity

High current buried arc welding process: Welding of thick plate welded structures requires considerable time for fabrication and weld strain removal heat treatment due to multilayer welding operations. The high-current buried arc welding process has therefore been developed to save welding time.

The buried arc is difficult to stabilise because it is prone to molten pool instability and irregular short-circuits, and this tendency is more pronounced in the high-current range where deep penetration is expected. Until now, this has prevented the process from being put into practical use.

In order to stabilise the buried arc, a low frequency modulated voltage control, based on external characteristics control has been developed^[9].

Figure 6 shows an example of current and voltage waveforms with low frequency modulated voltage control. Here, a high and low voltage period is repeated periodically, and different metal transfer modes are utilised in each period. In the high-voltage period, the rotating transfer mode is enabled to stabilize the buried arc space with support from the sidewalls of the molten metal, as shown in

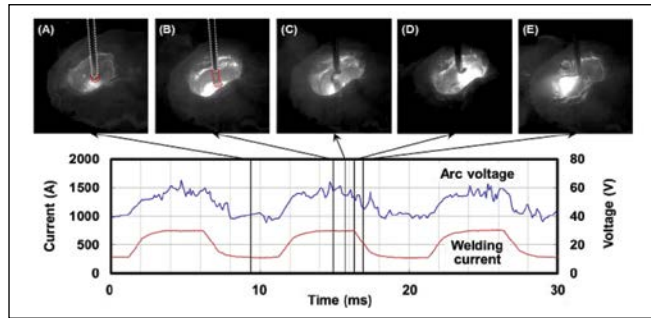


Figure 6: Arc phenomenon of the buried arc realized by the low frequency modulated voltage control.

Figure 6(B)-(E). However, in the rotating transfer, the heat input by the arc is concentrated in the direction of the sidewalls of the buried space, resulting in a relatively wide and shallow penetration.

Therefore, in the low-voltage period, the drop transfer mode is used as shown in Figure 6(A), where the arc is directed downward to give heat input to the deeper part of the base metal to ensure deep penetration. Through this series of operations, a stable buried arc can be achieved.

Figure 7 shows the results of welding joints with the same groove geometry with conventional CO₂ GMAW and high-current buried arc-controlled CO₂ GMAW, respectively. In this example, the comparison is made under welding conditions of 40 kJ/cm or less, which is the heat input limit in the Japanese Architectural Standard Specification for architectural steel frames. In conventional CO₂ GMAW, welding current, heat input, number of passes, and other construction conditions vary according to factory specifications and welding operators.

However, a welding current of 300 A or less is generally applied. For example, a welding current of 280 A requires seven welding passes. On the other hand, with the buried arc control GMAW, welding can be completed in four passes, which reduces welding time by nearly 50%.

Welding condition	Conventional GMAW	Buried Arc GMAW
Wire size / Welding current	φ 1.2 / 280 A	φ 1.2 / 400 A
Layers / Number of passes	5 layers / 7 passes	4 layers / 4 passes
Heat input	20 kJ/cm	35 kJ/cm
Welding time	3 min. 40 seconds	1min. 40 seconds
Groove shape		

Figure 7: Comparison of multi-layer welding result between conventional GMAW and buried arc GMAW.

Automatic pulsed waveform adjustment using rule-based AI: In high-speed welding using the pulsed GMA process for thin steel sheet welded structures such as automobiles, the arc length is shortened by lowering the set voltage to prevent the occurrence undercut, but this increases spatter generation.

In particular, large amounts of spatter is generated when a short circuit occurs during a pulse peak current period. In this case, if the pulse parameters can be adjusted so that any short circuit occurs during a base current period of the pulse, the molten droplets in the weld pool can be detached from the wire tip by surface tension, suppressing the spatter.

This has enabled a high-speed pulsed GMAW system to be applied in the auto industry, which can both suppress spatter and undercut. The system uses rule-based AI control that records the occurrence of short-circuits from time to time and automatically

adjusts the pulse peak time so that the short-circuit occurs during the base period^[9].

Figure 8 verifies the suppression of spatter and undercut during high-speed welding. In the first half of the bead, the set voltage is high relative to the welding speed, and although there is no spatter, undercuts occur. In the central part, the set voltage was lowered to suppress undercut, resulting in a short arc length, which caused short circuiting and spatter generation. In the latter part, spatter generation is suppressed while maintaining a short arc length by automatically adjusting the pulse peak time, and there is no undercut.

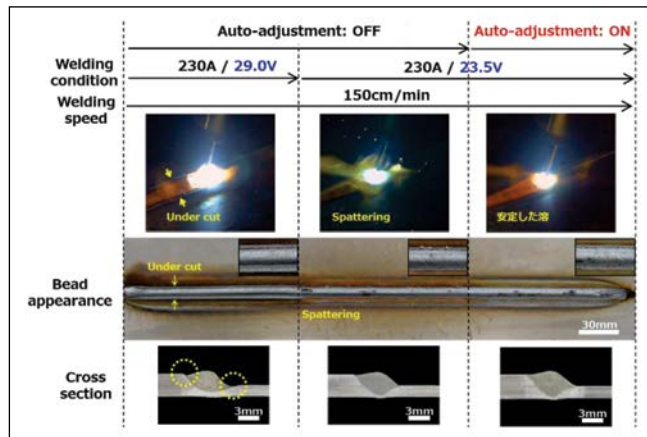


Figure 8: Effect of self-adjustment pulsed GMAW on undercut and spatter generation.

The Plasma Jet TIG welding process

Segment conductor (SC) distributed winding stators are used in motors for driving EVs^[10]. Loss reduction due to stator winding resistance is also necessary and is one of the quality targets required for the welding and joining the flat copper wire that makes up the stator coil.

TIG and laser welding are the main joining processes for welding flat copper wire. In TIG welding, as shown in Figure 9, an inner gas of the same or different type as the shielding gas flows through an inner gas nozzle installed around the electrode, causing the arc to constrict and a pulse current output of several hundred Hz ensures arc stiffness.

This welding method (Plasma Jet TIG or PJT)^[11], has been developed and applied as a superior process to laser welding in terms of production efficiency, weld quality, and equipment installation cost using multiple welding systems.

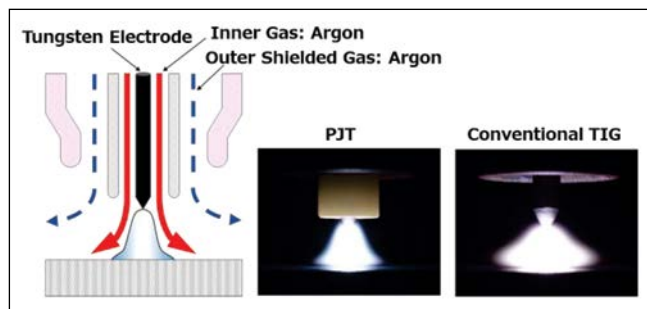


Figure 9: Plasma Jet TIG (PJT) welding.

Figure 10 shows the melting phenomenon of a flat copper wire using a constricted pulsed arc and the current waveform control sequence. The PJT arc has more stiffness and is more directional than the conventional TIG arc, and the plasma-like arc instantly melts and integrates the two flat copper wire ends to form a symmetrical molten hemisphere. This phase is followed by a downslope

period in the 10s of millisecond range to stop the arc, so that a hemispherical joint shape in which the ends of the flat copper wires are always symmetrical can be obtained – as shown in Figure 11.

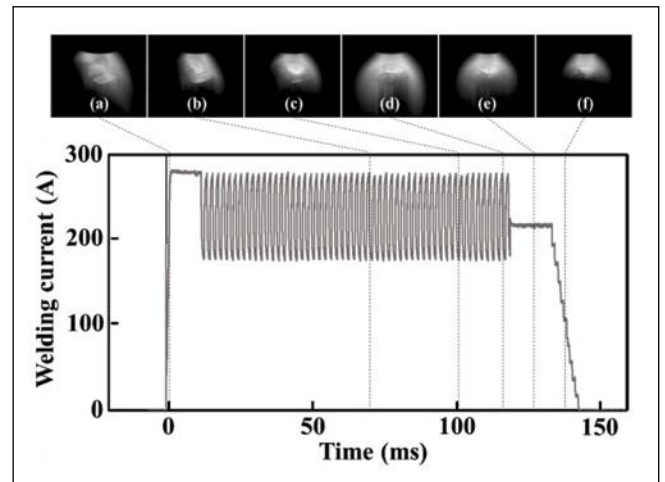


Figure 10: One cycle of rectangular copper wire melting with the PJT welding process.

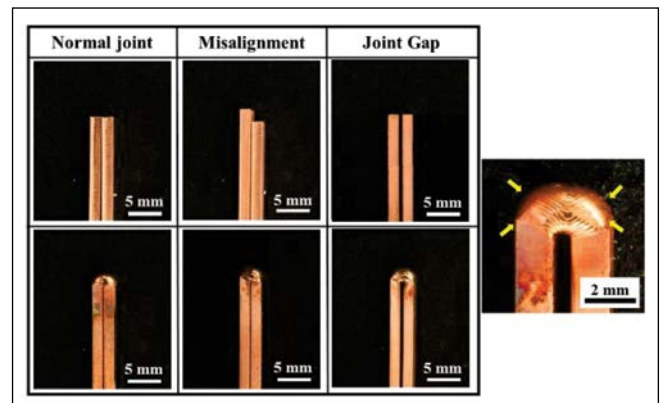


Figure 11: Joining results of rectangular copper wire with the PJT welding process.

The Laser Arc Hybrid welding process

Laser-arc hybrid welding is being researched and developed to overcome the disadvantages of arc welding and laser welding: by utilizing the advantages features of each process^[12, 13].

An example of a welding robot used for laser-arc hybrid weld-



Figure 12: Laser-arc hybrid robotic system.



ing is shown in Figure 12. The arc, placed behind the laser beam, is attracted to and stabilised by the laser-induced plasma. The laser creates a plasma with good electrical conductivity in the atmosphere near the arc, and a laser-molten pool is formed near the molten pool of the arc on the base metal. These factors stabilise the arc by facilitating smooth movement of the molten pool.

This arc stabilising effect is very effective in high-speed welding. In particular, in hybrid welding^[14] that combined the laser with ac-pulsed GMAW. The ac GMA process supplies the weld deposition at low heat input, while the laser arc secures wettability and penetration of the weld metal into the base metal, creating an excellent synergy effect. Good bead formation is possible, even when large joint gap exist, as shown in Figure 13.

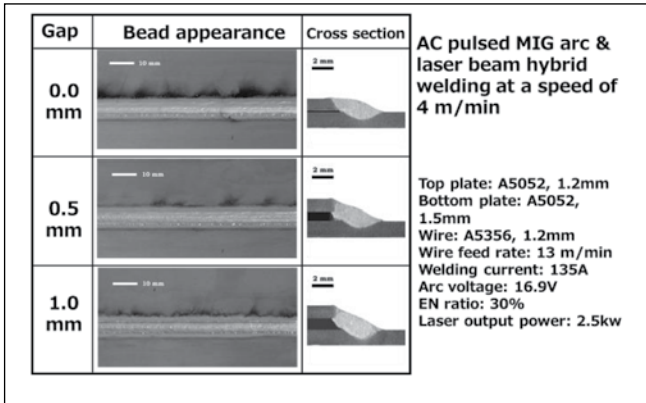


Figure 13: High speed welding results of aluminium alloy lap fillet joint by laser-AC arc hybrid process.

As shown in Figure 14, when a short circuit is detected, the wire feed direction is reversed, and the optimum short circuit release current is set to promote re-arc. As soon as an arc is established, the wire feed direction is reversed again and the polarity of the GMA welding current is switched to EN for the prescribed EN arc period ratio. During this same period, the output polarity is again switched over to EP: to ensure heat input to the base metal and to promote cleaning of the metal surface. At the same time, the appropriate arc length is maintained by voltage feedback control.

Figure 15 shows an example of lap fillet joint welding using an A6063 extruded aluminium alloy with a thickness of 2.0 mm at a welding speed of 10 m/min, which is being applied to welding EV battery cases and other applications^[15].

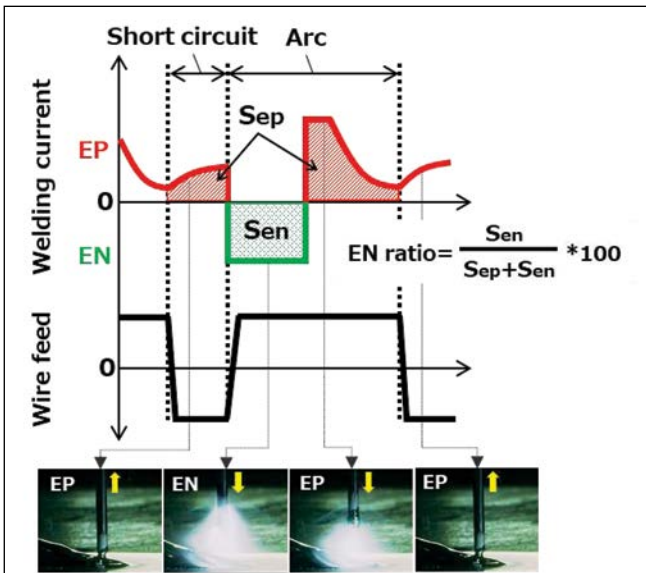


Figure 14: AC synchro-feed GMA process.

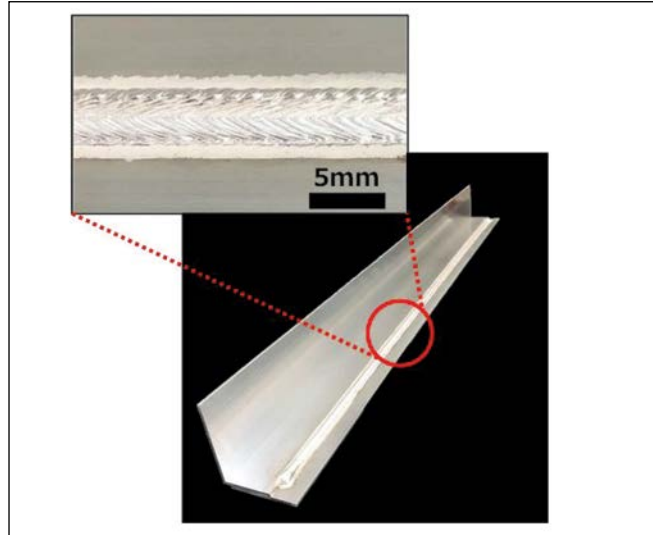


Figure 15: Extrude aluminium alloy welding result by Laser AC synchro-feed GMA hybrid process.

The Cold Spot joining process

Resistance spot welding is widely applied in the assembly of automobile bodies and parts. In recent years, the ratio of ultra-high strength steel plates (cold- or hot-stamped materials) with a strength of 1.0 GPa or higher applied to automotive parts has been increasing due to the need to reduce the weight of the vehicle body. Compared to mild steel plates, these high-strength steel sheets do not fit well with each other when clamped by electrodes. They have a narrow contact diameter, and the energizing area cannot easily be expanded. Therefore, the electrical resistance is higher and splash (spattering) is more likely to occur.

In addition, to secure the proper nugget size, it is necessary to use construction measures such as high applied pressure, securing the precise energizing current, and extending the energizing time, which shortens the life of the copper electrode.

Hence the need for the development of solid-state resistance spot joining or Cold Spot Joining (CSJ), which applies high pressure to the joint materials to reduce the joining temperature and complete the joint at a lower temperature than the melting point^[11,16].

Figure 16 shows the principle of this process. First, a pressurisation

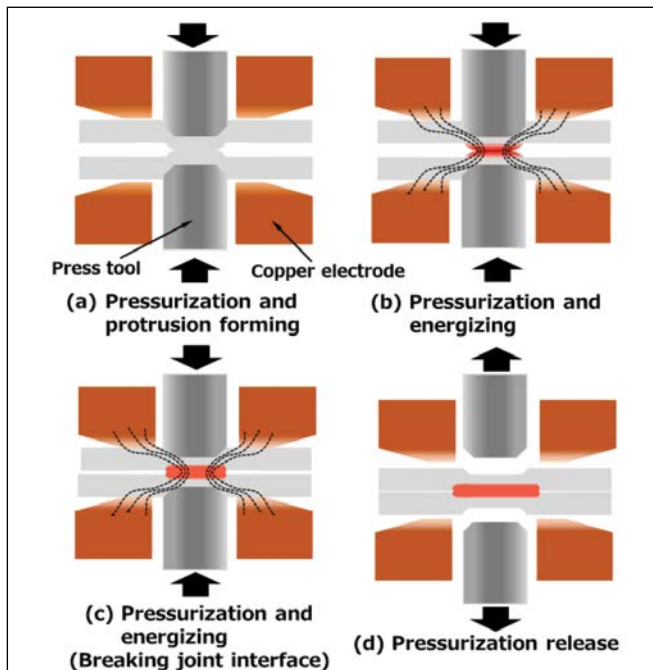


Figure 16: Principle of Cold Spot Joining (CSJ) process.



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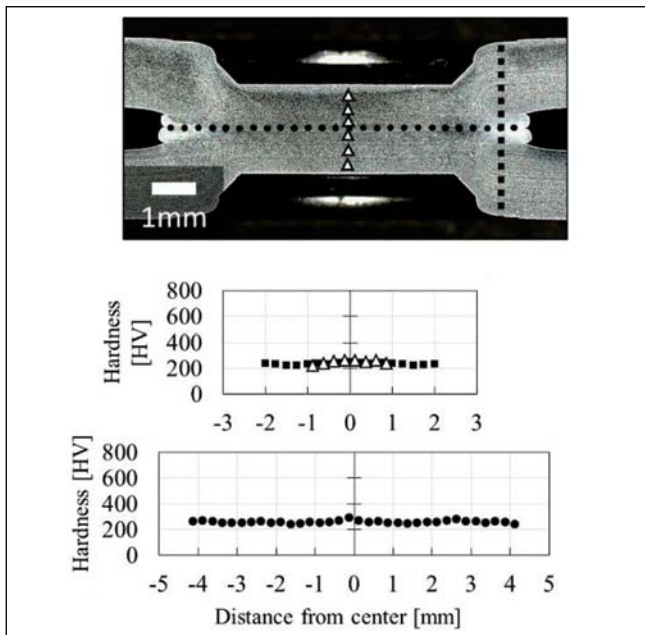


Figure 17: Joint cross-section and hardness distribution.

ing shaft placed in the centre of the cylindrical set of spot welding electrodes form protrusions on the materials to be joined and maintain high applied pressure while the current flow. Next, energization is started from the cylindrical copper electrode placed around the pressure shaft.

As the temperature of the joining interface area rises, the joining material softens and falls below the strength of the applied pressure, causing a break in the joining interface and contact between the newly generated metal surfaces. As the pressure shaft is pushed in further, the deformation of the joining interface progresses, and the surface layer of the interface is pushed outward to form the joining zone.

These processes are completed in a single process, from forming the protrusions to the energisation and the end of joining.

Figure 17 shows the joint cross section and hardness distribution of CSJ in carbon steel S45C (JIS G 4051) with a plate thickness of 1.6 mm and a C content of 0.45%; joined at a pressure of 450 MPa with a current flow of 3.5 kA. The hardness of the entire joint is

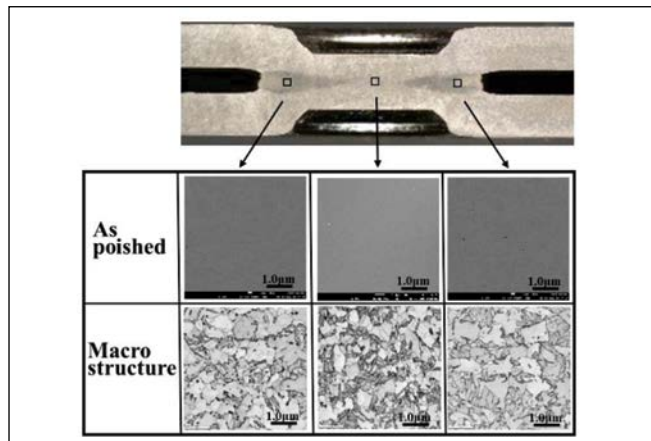


Figure 18: Microstructure at joint interface of 1.0 GPa class high strength steel.

equivalent to that of the base metal, and martensitic transformation does not occur because temperature remains below the melting temperature of the base metal for the duration of the process.

Figure 18 shows a macro section of the joining area of a 980 MPa-class ultra-high strength steel sheet. There is no lack of fusion across the entire interface and a good joint is obtained.

Summary

These welding and joining technology developments in Japan within the last five years will contribute to social issues such as carbon neutrality and eliminating labour shortages in future manufacturing.

Most of these developments are based on technology that started from the intuition and ideas of engineers and scientists, highlighting the value and the necessity of academic support and sustainable research and development into welding and joining technologies based on the integration of technology and science.

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Acknowledgement

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A hybrid methodology for orbital pipeline welding

This white paper by Laurent Baudouin and Francesco Ciccomascolo of voestalpine Böhler Welding presents results of comparative orbital pipe welding trials based on using conventional V-Bevel weld preparations. A hybrid girth welding method using the company's mechanised pipeRunner® bug and band system for fill and cap passes was compared to manual SMAW welding for all passes. In both cases, SMAW welding was used for the root and hot passes.

Welding operations for onshore pipelines focus primarily on girth welds for joining pipe-to-pipe. The predominant material for these pipes is often unalloyed and low-alloyed steels and, in such cases, manual shielded metal arc welding (SMAW) employing cellulosic electrodes remains the prevalent choice.

While gas metal arc welding (GMAW) mechanisation is already well-established in this domain – characterised by a sophisticated approach involving narrow grooves cut using on-site bevelling machines and internal line-up clamps, and welded using advanced bug and band systems – there is growing interest in a 'hybrid' solution. This hybrid approach seeks an optimal balance between flexibility, ease of use and productivity, relying on bug and band systems and rutile flux-cored wires (FCAW).

The hybrid methodology

In this hybrid girth welding methodology, fill and cap welding are executed with uphill progression using a conventional V-bevel joint preparation and rutile flux-cored welding (FCAW) wires. The root and the hot (2nd) pass are initially performed through

SMAW, but in some specific cases, Gas Tungsten Arc Welding (GTAW) or Gas Metal Arc Welding (GMAW) may be preferred.

This hybrid approach offers several advantages compared to the downhill welding technology, which typically uses solid wires in a narrow gap:

- **Flexibility:** The hybrid solution allows for greater adaptability in welding operations, accommodating variations in project requirements and conditions.
- **Ease of use:** The methodology is designed to be user-friendly, simplifying the welding process and enhancing operational convenience.
- **Productivity:** Despite the ease of use, the hybrid approach does not compromise productivity, providing efficient and effective welding solutions.

The combination of bug and band systems and rutile FCAW presents a compelling alternative, addressing the specific challenges of onshore pipeline welding while leveraging the benefits of the uphill welding techniques.

The hybrid solution stands as a pragmatic compromise that optimises the welding process in terms of performance,

versatility, and operational simplicity.

However, there are certain drawbacks to the hybrid approach. Despite a substantial deposition rate per pass, the hybrid process tends to be slower than the downhill procedure, which impacts overall welding efficiency. Also, the presence of slag from the flux impedes the use of double torch equipment, which can reliably be used in narrow gap weld grooves with solid wires to further improve the productivity.

Mechanical properties, especially weld-metal toughness, may be lower due to higher heat input with the hybrid process, and the use of fine-tuned welding consumables such as Böhler Welding's specialised diamondspark RC-pipe range of flux-cored-wires for pipelines is necessary to mitigate these effects.

Having to fill a V-bevel instead of a narrow gap also results in higher filler metal consumption, which influences consumable the costs.

On the positive side, the hybrid approach offers several advantages. The hybrid method requires less investment in equipment compared to the complex downhill procedure. It eliminates the need for a site bevelling machine and internal clamp, which streamlines the welding preparation and setup. A single set of welding parameters and a simpler, less expensive bug and band system contribute to operational ease, while the hybrid approach is inherently more operator friendly, reducing the complexity of the welding procedures.

Most importantly, compared to the downhill process, the hybrid process is less sensitive to lack of fusion and porosity, resulting in far fewer indications from post-weld non-destructive testing (NDT) – zero indications in cases where the procedure is carried out diligently.

In summary, while the hybrid approach introduces certain challenges, its advantages in terms of equipment cost, simplicity, and operator ease make it a



In combination with diamondspark flux cored wires, Böhler Welding's pipeRunner® for pipeline welding can deliver flawless girth welds with excellent material properties.



viable and attractive option for onshore pipeline welding, especially when considering trade-offs in deposition rates and mechanical properties.

In comparison with all passes being completed using SMAW electrodes, the hybrid option presents several advantages, including: improved productivity due to higher travel speeds and deposition rates; reduced downtime due to the continuous workflow associated with using the a pre-programmed bug-and-band system for the more time consuming fill and capping runs; high consistency, quality and repeatability; and much lower repair rates due to porosity or lack of fusion indications.

To fully realize the potential benefits, however, it is imperative to use flux-cored wires specifically designed for pipeline applications for the fill and capping runs. These provide proper support to the weld bead, especially in the critical positions between 6:00 and 4:00 o'clock. Typical consumables include: diamondspark 52 RC or one of the diamondspark X60 to X80 pipe range of consumables, depending on the base metal pipe specifications.

Another essential component of this Hybrid solution is a bug and band system that is fully programmable, digitally controlled, and offers high precision welding arc manipulation.

Productivity evaluation

To evaluate the productivity gains, trial welds were conducted on Grade API 5L X 70 pipe with a diameter of 910 mm and a wall thickness of 15.0 mm. The trial involved the described method and a fully manual SMAW process on comparative weld joint.

The root consumable for both methods was FOX CEL (AWS A5.1: E6010), a cellulose electrode designed for vertical-down welding of pipelines. The hot pass was completed using SMAW with FOX CEL 80-P (AWS A5.5: E8010-P1).



Böhler Welding's hybrid girth welding methodology uses the pipeRunner® bug and band system for fill and cap welding, with uphill progression using a conventional V-bevel joint preparation and rutile flux-cored wires.

Weld Area	Position	Temp (°C)	Charpy CTOD test results (J)			
			1	2	3	AVG
Root	12 o'clock	-30	60	60	54	58
		-60	29	41	29	33
	6 o'clock	-30	43	51	45	46
		-60	36	38	31	35
Cap	12 o'clock	-30	82	84	88	85
		-60	40	42	48	43
	6 o'clock	-30	80	77	84	80
		-60	43	54	52	50

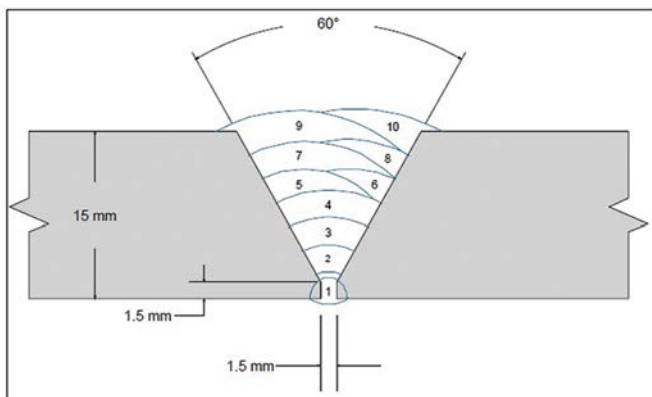
Table 1: Charpy V-notch test results in a girth weld of a Grade API 5L X 70 pipe welded using the hybrid approach.

For the mechanised fill and capping passes, the Böhler Welding pipeRunner® bug and band system with the TERRA 400 PRM welding power source and the diamondspark X70 RC-Pipe (AWS A5.29: E91T1-K2M-JH4) flux-cored wire specifically designed for pipelines were used, moving vertically up from the 6:00 o'clock to 12:00 o'clock positions. This approach resulted in a defect-free, high-quality joint with an excellent bead appearance, which was completed with

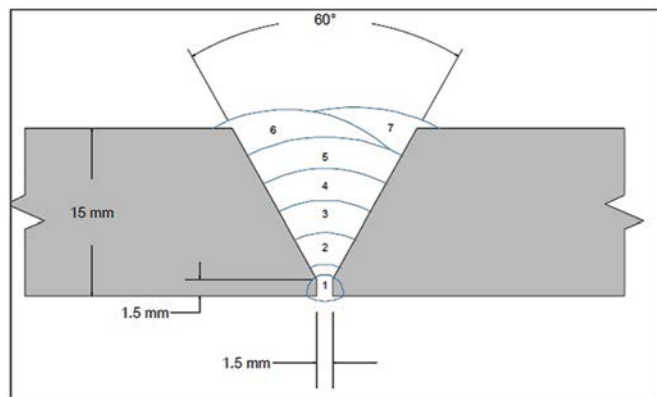
Tensile test	Result
Yield strength (MPa)	537
Tensile strength (MPa)	613
Elongation (%)	27,8

Table 2: ASTM E8 Tensile Test results from a longitudinal sample taken at 3 o'clock.

five mechanised FCAW fill and cap passes in addition to the SMAW root and hot passes – seven weld passes in total. In comparison, the manual root, fill and cap passes with FOX CEL and FOX CEL 80-P required a total



Fully SMAW procedure welding sequence



pipeRunner® 'hybrid' procedure welding sequence

A comparison between the fill sequences for a pipe girth welding trial: Left: Pipe welded using a fully manual SMAW process. Right: Welded using a hybrid process with the fill and cap passes completed using the pipeRunner® bug and band systems with a rutile flux-cored wire.



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of ten passes – three additional layers of weld deposit compared with the hybrid process.

As indicated in the tables on page 19, compared to the joint completed using the full cellulosic SMAW procedure, the use of pipeRunner® with the diamondspark flux-cored wire led to a 51% reduction in arc time and a 66% reduction in total welding time, including fit-up.

Additionally, there was a 46% net saving in terms of the mass of the consumables deposited. It is noteworthy that larger diameter or heavier wall thickness can result in further savings, as well as the utilisation of multiple welding stations, each dedicated to executing one or a few passes.

Welding of clad 625 X 65 and stainless steel Grade 1.4301 (304L) pipe

Excellent pipe welding results were also achieved on a Clad 625 API 5L X65 pipe using the UTP 2.4 mm A 6222Mo-3 TIG rod for the root and the hot pass, followed by mechanised gas shielded flux cored welding using a pipeRunner with a 1.2 mm FOXcore 625-T1 wire for the fill and cap layers.

Stainless-steel pipe girth weld using Grade 1.4301 (304L) was also successfully completed using the hybrid welding process. In this case, the 304L pipe was welded with the 2.4 mm Thermanit JE-308 L TIG rod consumable for the root and the hot pass, followed by the pipeRunner welding with the FOXcore 308L-T1 cored wire for the fill and cap layers.

When used for hybrid welding, the combination of the pipeRunner® and the FOXcore range of high-alloyed flux-cored wires offers excellent weld bead appearance with a significant reduction in post weld cleaning and a substantial improvement in productivity compared to fully manual pipeline welding for fill and cap layer.



Weld bead appearance for the fill (left) and cap (right) passes completed using vaBW's pipeRunner® bug and band mechanised welding solution.

Conclusion

In conclusion, the hybrid approach, in terms of productivity, is higher than standard stick electrodes, even cellulosic ones, while it is lower than full mechanised welding. However, there are advantages in terms of equipment cost, simplicity, and operator ease, making it a viable and attractive option for onshore pipeline welding.

The specific design of voestalpine Böhler welding flux-cored wires is able to meet critical project specifications, even when projects require good toughness properties (CTODs). The hybrid procedure is capable of providing solutions for clad pipes and other materials where flux-cored wires might be used.

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ESAB adds productivity enhancing WeldModes to Warrior range

Jannie Bronkhorst, product manager for Welding and Automation at ESAB South Africa, talks about the WeldModes incorporated into the latest range of ESAB Warrior® Edge Power sources and associated equipment to optimise productivity and promote consistency and quality.

ESAB's latest Warrior® Edge 500 DX multi-process welding power system features a range of new WeldModes to optimise the welding performance for specific applications, including thin/sheet materials, root welding, root welding of pipe, and high speed open arc welding applications.

Advanced WeldModes for MIG/MAG/GMAW welding include: THIN, ROOT, ROOT Pipe and SPEED, while an Advanced Pulse WeldMode is also available for enhanced arc stability and weld pool control at faster travel speeds and higher average currents, all of which offer reduced spatter for less post-weld clean-up.

“With Warrior Edge DX, manufacturers

and fabricators can change good welders into great welders, while optimising productivity, improving quality and consistency, and simplify training,” says Jannie Bronkhorst of ESAB South Africa.

In addition, the user interface has been made exceptionally welder friendly. Users set up the machine after a wire spool change by choosing the material being welded on an intuitive TFT LCD interface attached to the RobustFeed Edge DX wire feeder. The feeder's front panel features daily controls, Quick Job (memory) buttons, WeldMode selection, and RFID badge-controlled access to promote consistency and to help manage workforces with varying degrees of skill.

ESAB's new Warrior Edge 500 DX also comes with built-in connectivity and a lifetime subscription to the InduSuite Weld-Cloud Fleet of online software applications developed to help fabricators track and optimise production progress, quality, and compliance.

Productivity enhancing short-arc WeldModes

The THIN WeldMode for short-arc MIG/MAG/GMAW welding has been introduced to reduce spatter levels and heat input into the weld joint, which minimises distortion when welding thin plates from 0.75 to 3.0 mm (22 to 11 gauge).

Also based on the short-arc MIG/MAG/GMAW welding process, ROOT WeldMode is optimised for root passes on plates in all welding positions. It creates a smooth, low spatter arc, even while weaving, making the arc easier to direct and control.

In addition to above features, ROOT Pipe mode offers excellent gap bridging capabilities and is optimised for vertical down pipe-root welding applications.

The THIN, ROOT and ROOT Pipe WeldModes all use an enhanced short-arc transfer processes with a novel type of adaptive current control that delivers consistent and smooth metal transfer for a more stable weld puddle. “Improved stability gives the operator better

control even when welding at faster travel speeds, plus it suppresses the conditions that lead to the formation of spatter,” explains Bronkhorst.

Even though these WeldModes deliver lower heat input for reduced distortion, their gap-bridging ability promotes consistent fusion without excessive reinforcement on the underside of the joint. In addition, there is no need for an additional voltage sensing cable, which simplifies set-up and reduces the risk of mistakes.

SPEED WeldMode and synergic welding

The new SPEED mode creates a more focused arc by taking a conventional spray transfer arc and overlaying a modified pulsed current waveform over the top of it, which stiffens the arc. The benefits of SPEED mode include improved control at higher travel speeds, reduced spatter, deeper more focused penetration in fillet welds, and the ability to weld in narrower grooves with a lower risk of fusion defects.

The Warrior Edge 500 DX also offers synergic Pulse MIG WeldMode, conventional and synergic MIG/MAG welding, MMAW/SMAW, Live TIG and carbon arc gouging, and it comes with a rated welding power output of 500 A at 60% duty cycle.

The new capabilities embedded in the Warrior Edge 500 DX enable ordinary welders to benefit from sophisticated WeldModes without needing continuous training or relying too much on individual operator skill, continues Bronkhorst. The intelligence inside the system makes set-up fast and welding easy. When using a synergic WeldMode, operators can fine-tune performance simply by adjusting the wire feed speed and trim control knobs, and the system will maintain optimised arc characteristics and deliver excellent weld quality results.

Warrior Edge systems also offer an Arc Dynamics function where the operator can set welding parameters and fine-tune them by turning a single knob: creating a more focused arc for faster travel speed when making fillet welds; adjusting arc energy for specific welding conditions; and optimising stability for a specific travel speeds,



Developed with productivity in mind, the Warrior® Edge is one of the most advanced MIG/MAG/GMAW welding systems ESAB has ever built.



The Warrior Edge power source is designed to be used seamlessly with the RobustFeed Edge wire feeder, which features an effective and quick to set-up operator management system and an RFID-reader to scan operator badges.

wire stick-out for better control of the weld pool, and weld bead geometry. Arc Dynamics works in all synergic WeldModes to provide customised control over welding.

The Warrior Edge power source is designed to be used seamlessly with the RobustFeed Edge wire feeder, which features an effective and quick to set-up operator management system and an RFID-reader to scan operator badges. This allows parameter-limit locking for improved repeatability and adherence to weld procedure specifications (WPSs).

The feeder also features ESAB's new TrueFlow digital gas control technology for greater gas shielding precision, confidence and cost savings. The system automatically prevents insufficient gas flow and optimises flow during arc starts and welding, a common source of quality issues and wasted gas. TrueFlow can save between R1 200 and R25 000 per year, per machine, in gas wastage



The feeder also features ESAB's new TrueFlow digital gas control technology for greater gas shielding precision, confidence and cost savings, which can save between R1 200 and R25 000 per year, per machine, in gas wastage for typical use cases.

for typical use cases, Jannie Bronkhorst reveals.

Together, the Warrior® Edge 500 DX multi-process power source and RobustFeed Edge DX wire feeder with THIN, ROOT, ROOT Pipe, SPEED and Pulse WeldModes, offer better arc stability and control at faster travel speeds with reduce spatter.

“Developed with productivity in mind, the Warrior® Edge is one of the most advanced MIG/MAG/GMAW welding systems ESAB has ever built. The new streamlined interface delivers easy-to-set welding parameters for the machine to deliver excellent welding performance.

“Reduced welding times, post weld cleaning and repair rates, with better finished weld quality, along with the work flow efficiency improvements available from WeldCloud™ will surely deliver value for money and a rapid return on a Warrior® Edge 500 DX investment,” concludes Jannie Bronkhorst.

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Sanipipe's UHP orbital welding capability

Sanipipe Engineering Services has established a new orbital welding capability for the delivery of food grade and ultra-high purity (UHP) welding pipework for the food, beverage, HVAC and pharmaceutical industries. *African Fusion* talks to MD, Donald Johnson; QA manager Andre Hodnett; and health and safety and orbital welding coordinator, Ian Munazvo.

Sanipipe Engineering Services was formed in 2005 when its current MD, Donald Johnson, who was working with a project house as a qualified boiler-maker at the time, was prompted by some colleagues to establish his own company. "With the support of those I already knew, I started a small fabrication company offering high-end TIG welding services, mostly for food and beverage and HVAC projects, but also for the steam boiler sector," Johnson tells *African Fusion*.

"We are contractors to consultants such as High Calibre Engineering, Project Assignment, AECI Water, Appletizer (Coca-Cola), BBI Solutions, PepsiCo Simba, PepsiCo Ceres Fruit Juices and Aspen Pharmacare. We get design drawings and isometrics from them, and we fabricate exactly according to their technical specifications," he adds.

In a drive to deliver better weld quality, the company was certified to ISO 9001 2015 in 2016, and just before Covid hit in 2020, Sanipipe was awarded ISO 3834-2 certification by the SAIW. The move to adopt orbital welding technology into the company's offering began with enquires from the South African pharmaceutical industry. "We could

not reach the purity standards required for pharmaceutical work without orbital welding so, following some good advice from Polysoude, we took the plunge. We now have two Polysoude orbital welding systems with all the orbital heads we need to accommodate pipe diameters from 10 mm to 104 mm," Johnson tells *African Fusion*.

From the outset, Sanipipe has focused on the specific pipe welding needs required for sanitary applications, ie, those for the food, beverage, pharmaceutical, oil & gas and similar industries. As well as ensuring that the pipe welds are flaw-free and mechanically sound, sanitary welds must also be very smooth, uncontaminated and easily cleanable to maintain the required standards of hygiene. Stainless steel tubing is usually used as a food-safe contact material but, to remove any chance of contamination inside of these tubes, the surface finish must be free of any discontinuities that could become sites for microbial growth.

In addition, to maintain a smooth and corrosion-free surface in the inside of the welded pipes and tubes, oxidation must be avoided. During welding, therefore, the weld seams must be back purged to



exclude oxygen, using an inert gas such as argon.

"Our orbital welding, together with back purging, enables us to meet these requirements at the highest levels," continues Johnson. "For most food & beverage applications, 304L and 316L stainless tube is acceptable, but for the pharmaceutical industry, we use UHP-grade Dockweiler tubing, which comes with an electro-polished surface finish of the highest quality," he says, adding that this gives Sanipipe the ultra-high purity (UHP) welded tubing compatibility needed to service the pharmaceutical and medical industry at the highest quality levels.

"We can accommodate wall thicknesses of between 1.2 and 3.0 mm, typically ASTM Schedule 5 or 10, and we can produce an orbital TIG weld in a single pass without the need for filler material," continues Sanipipe's orbital welding coordinator, Ian



The Sanipipe team, from left: Trevor Cekiso, procurement; Ian Munazvo, HSE and Orbital Welding Co-Ordinator; Jacqueline Schippers, office administrator; Phillip Mushonga, projects manager; Gino Cooper, maintenance manager; Andre Hodnett, quality manager; and Donald Johnson, managing director.

Orbital welding, together with back purging, enables Sanipipe to meet UHP sanitary requirements at the highest levels.



Boreoscope inspection is regularly used to determine the finished quality of the inside surfaces of tubes and pipes.



Carbon filters for AECI water at CERES Fruit Juices.



A UHP fabrication for Coca-Cola being completed at Sanipipe's Cape Town facility.

Munazvo. “The welding heads enable us to get a near perfect fit up with no gap, and our procedures enable us to slope in and out so as to avoid stop-start imperfections.”

To purge the oxygen from the inside of the pipe and to ensure adequate purge purity levels while welding, Sanipipe is using a system recommended by Polysoude. “We use a TECPEN MAP oxygen analyser to ensure that all the oxygen has been removed from inside the pipe before starting to weld, which gives us precise oxygen measurements. We typically need to have less than 20 ppm of oxygen in the purge gas but for some of the critical pharmaceuti-

cal applications, this can be as low as 5.0 ppm,” says Munazvo, adding that welding and purging at this level is done according to the requirement of the ASME, Bioprocessing Equipment (BPE) code.

Sanipipe can also offer pipe and tube system cleaning services for any newly installed or repaired circuit. “We offer three stages of cleaning, including degreasing, pickling and passivation. These would all be completed one after the other, and we can do this at our Cape Town facility or onsite anywhere in South Africa,” he adds.

The advantages of ISO 3834 certification

In the past, International Standards did not play a big part in South Africa’s fabrication industry, so when things went wrong, there was very little traceability, says QA manager, Andre Hodnett. That has all changed, though, particularly where higher quality work is required.

“ISO 3834 certification is now a must for contractors wishing to do work in our field. It assures clients that when a fabrication is completed by an ISO 3834 approved

company, it has been done properly at every step of the process, and the finished product meets all the requirements. And a full set of documentation is available to prove this,” he says.

“In the event of problems occurring in service, the documents can be used to trace what or who is responsible, for insurance companies or the Department of Labour, for example,” Hodnett says, adding that ISO 3834-2 is like a guarantee that welding work is being done to the highest quality standards.

“Our procedures, qualifications, certifications and the specialist focus we have on sanitary welding put us one step above our competitors. Now with the new orbital welding capability to meet UHP sanitary standards, we do not believe anyone can touch us,” concludes Donald Johnson.

<https://sanipipe.co.za>

The Britestar 1600: the electrolytic cleaning

Steve Hutchinson of Starweld talks about the newly launched Britestar 1 600 W electrolytic stainless steel weld cleaning solution, which has been designed and developed in South Africa out of the company's Boksburg premises near Johannesburg.

Stainless steel is an alloy composed mainly of iron (Fe) with the addition of 10.5 to 12% chromium (Cr) as the primary alloying element. When exposed to normal atmospheric air, chromium reacts with the oxygen in the air to create a protective layer on the surface of the material. "This passive layer is very thin, but strong enough to prevent additional oxygen and moisture from penetrating and attacking the bulk material underneath. This is why stainless steel possesses unparalleled anti-corrosion properties," begins Steve Hutchinson of Starweld.

The intense heat from the welding process damages the stainless steel's protective oxide layer, resulting in discolouration, and rendering the material susceptible to rust and bacterial infestation. This is a major concern, particularly in sensitive manufacturing sectors such as the health-care and food industries.

"It is vital, therefore, that post weld cleaning takes place in order to restore the weld's integrity, durability and appearance," he adds.

There are several traditional methods for cleaning stainless steel welds:

- Mechanical methods, using powered stainless-steel grinding discs and wire brushes or rotating plastic brushes, for example.
- Pickling, which involves the use of

extremely strong and hazardous acids, such as hydrofluoric or sulphuric acid. This removes any oxide scale and heat tint, while dissolving steel flecks on the stainless steel surface.

- Passivation is a vital process that must follow pickling after the corrosive pickling paste has been removed to allow the protective oxide layer to reform. But passivation can also be applied on its own to restore or reinforce the protective layer on a stainless steel surface.

The mechanical method uses consumables such as grinding discs and brushes. The process also demands considerable physical effort. Accidents may occur if the equipment is not used correctly. Mechanical cleaning can also leave scratches and sometimes miss spots, leaving room for possible further corrosion to occur. Also, whilst removing contaminating particles, this process does nothing to restore the passive layer on the stainless steel surface. "It can provide a solid prerequisite for this to occur naturally over time, but there is no guarantee that the chromium oxide layer will form fast enough to prevent the reappearance of rust," Hutchinson points out.

Pickling, while thorough in removing annealing colours, results in a time delay between when the chemical is applied and when the actual pickling process begins. Over-pickling can occur if the chemical is



not passivated once the weld cleaning is complete. This can result in either pitting or thinning of the metal.

In addition, there are serious risks to both human health and the environment when using these highly corrosive and toxic chemicals, which demand meticulous safety measures to be used at all times.

Furthermore, the disposal of the used chemical can present problems, especially in an environment where food, beverage or pharmaceutical products are being produced. Pickling solutions are also costly and cannot be used very efficiently since large quantities of the solution are wasted during the process.

The Britestar 1600 electrolytic cleaning machine

Starweld's locally developed Britestar machine uses a completely different process, Steve Hutchinson tells *African Fusion*. "The Britestar makes use of an electrolytic pro-



A simple push button operating system has been developed, with a digital display screen that confirms the menu selected as well as the power settings.



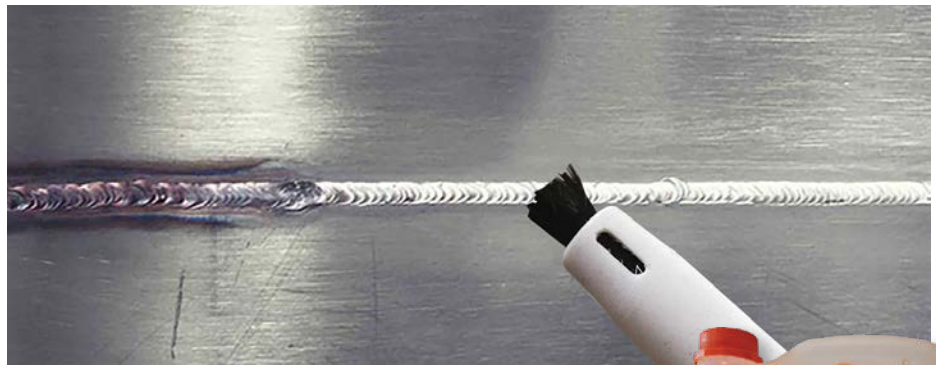
A current-conducting carbon fibre brush is used to apply the solution to any discoloured areas of the stainless steel, which both removes the damaged surface oxides and passivates the chromium-rich surface layer at the same time.



solution from SA's Starweld



The Britestar 1600 chemical cleaning, etching and marking machine makes use of an electrolytic process, passing a low voltage electric current through a mild chemical solution.



Above: This process will not only remove imperfections on the surface that the welding process has caused, but it will instantly restore the passivating oxide layer required to return the stainless steel back to its protected state.

Right: The chemicals needed for electrochemical cleaning using the Britestar 1600 are locally available and very affordable. In addition, small quantities can perform large amounts of cleaning, making the system an economical stainless steel cleaning and repassivating processes.



cess. This is done by passing a low voltage electric current through a mild chemical solution. A current-conducting carbon fibre brush is used to apply the solution to any discoloured areas of the stainless steel, which removes the damaged surface oxides and passivates the chromium-rich surface layer at the same time," Hutchinson explains, adding that the current conducting fibre brush used is able to reach in between the ripples in the weld bead, ensuring that thorough and instant cleaning takes place.

Hutchinson outline ten reasons for adopting Starweld's Britestar for cleaning welded stainless steel:

- 1 A fast and immediate solution:** The Britestar electrolytic cleaning process is efficient and undoubtedly faster than traditional mechanical or chemical cleaning techniques. This method stands out in that it is a one-step process that ensures the immediate restoration of the passive layer, mitigating any risk of further corrosion.
- 2 Ultra effective:** This process will not only remove imperfections on the surface that the welding process has caused, but it will instantly restore the passivating oxide layer required to return the stainless steel to its protected state. The mechanical grinding process may remove dirt and discoloration from the welds, but it does not assist in restoring the protective layer. It relies on the slow unassisted process of the protective layer returning naturally. During this delay, the welds and the plate are

vulnerable to further contamination.

- 3 Versatile:** The Britestar 1600 has both an AC and a DC menu. The AC menu performs the cleaning function, and the DC menu is designed to polish the stainless material.
- 4 Cost effective:** The chemicals needed for electrochemical cleaning using the Britestar are very affordable, and the fact that small quantities can perform large amounts of cleaning makes it the most economical stainless steel cleaning and repassivating process.
- 5 Easy to operate:** A simple push button operating system has been developed, with a digital display screen that confirms the menu selected as well as the power setting. In addition, there is a standby control that mutes the machine's power when not performing the cleaning, allowing the brush to be laid down on a steel work piece without harm.
- 6 Electrically safe:** The Britestar operates at low output voltages, well below the maximum permissible South African Occupational Health and Safety Requirement, eliminating any risk of electrical shocks, even if wet hands come into simultaneous direct contact with the brush and earth.
- 7 Energy efficient:** The advantage of being inverter based, means that the electricity consumption is extremely low, unlike transformer-based machines.
- 8 South African designed and manufactured:** Being South African designed and manufactured not only means the pricing of the unit is substantially

less than units manufactured in Europe and in the USA, it also guarantees servicing back-up and future availability of both the cleaning solution and consumables.

- 9 Lightweight and portable:** The Britestar power source weighs a mere 6.0 kgs, and has a pick up strap to enable it to be lifted with one hand. It is powered off a standard 220 V, 15 A socket. A robust holdall carrying case houses the unit, the cleaning brush cable and earth cable. All this makes the Britestar machine easy to transport and ideal for site work.

- 10 Extended warranty period:** The Britestar power source has a 24 month warranty period. This includes all the electronic components in the unit, giving the purchaser complete peace of mind when making the purchase.

"The Britestar 1 600 electrolytic cleaning machine is designed for any company involved in the welding of small to medium size stainless steel components. It is also ideal for contractors performing onsite work in food, beverage and pharmaceutical factories, where rapid, safe cleaning is preferred.

"This system removes the risk of manufactured products being contaminated, while also overcoming the problems associated with the disposal of large volumes of chemicals post cleaning," Steve Hutchinson concludes.

www.starweld.co.za

BRITE STAR



THE FUTURE OF STAINLESS STEEL WELD
CLEANING, MARKING AND ETCHING

Sales Team: Steve Hutchinson / steve@starweld.co.za / sales@starweld.co.za

Steinmüller Africa's remarkable safety milestones at power stations

Rudolph Botha, Health and Safety manager for Steinmüller Africa, and Arnoux De Bruin, the site-based maintenance manager at the company's contracted Bethal-based power station, highlight the excellent safety records being achieved at Eskom's Bethal and Kriel Power stations by Steinmüller's onsite maintenance teams.

Steinmüller Africa, a leading manufacturer and maintenance supplier of piping and boilers for steam and high-pressure industries, has achieved safety milestones at its contracted Kriel and Bethal power stations in Mpumalanga. Over a period of three years and 10 months, Kriel power station achieved an outstanding 4 095 154 man-hours without a Lost Workday Case (LWDC), while Bethal achieved 3 895 LWDC-free man-days.

The extensive duration of a safe environment is testament to the team's unwavering commitment to safety, and maximised uptime and productivity for clients. As Rudolph Botha, the company's Health and Safety Manager, proudly says, "This accomplishment serves as a beacon of light in a challenging industry. Knowing that our employees go home safely to their families is more than a statistical achievement for us. We look forward to maintaining this progress."

Botha explained the method for this success, "Establishing a safety-first culture is a priority. Our precautions, from programmes to corrective actions, are in place to yield benefits and not to tick



Steinmüller Africa's maintenance team at the Bethal-based power station.

boxes." Consistent reinforcement of the importance of safety is pivotal in maintaining impressive safety records, "Ensuring that each employee understands that safety for themselves and others is in their hands, and management leading by example, has been key for an empowered workforce," Botha emphasises.

Arnoux De Bruin, maintenance manager at the company's contracted Bethal-based power station, expressed immense pride in this achievement: "This is a great ac-

complishment, and I am proud of each individual team member who contributed towards this".

Reflecting on the company's safety culture, De Bruin concludes: "Safety is not only driven on specific days or by specific tasks. It is an every-day, -hour, -minute and -second ethos and the starting point of each process. Steinmüller Africa is dedicated to safety and looks forward to setting new records in safe plant uptime."

www.steimmuller.bilfinger.com



Steinmüller Africa's onsite maintenance workshop at the Bethal Power Station.

Welding and end-of-line handling solutions for African industry

African Fusion talks to Jan 't Hart, Yaskawa Southern Africa's national sales manager; and sales engineer, John Mostert, about some notable robotic welding and handling applications that are now being implemented to help raise the accuracy, quality, productivity and competitiveness of manufacturers on the African continent.

African manufacturers are under increasing pressure to raise their quality and accuracy, on one hand, and productivity and competitiveness on the other. Without adopting more robotics and automation in their production processes, this contrasting combination of imperatives is very difficult to achieve. And while robots have long been a core part of large volume assembly plants, most notably the local automotive industry, Yaskawa is now finding people from diverse industries interested in using robots to help them rise to this challenge.

Yaskawa sales engineer, John Mostert, cites a solution developed for a copper exploration company that drills cores for mapping underground geology and locating seams for mine development. "We have been asked to develop a robotic welding system to overcome problems being experienced with drill pipes, which are used to drill thousands of holes and extract core samples," he explains.

These pipes, he continues, consist of

an inner and an outer section. Each pipe section is about 3.0 m long and, when being used to drill, these are bolted onto one another from the top as drilling proceeds. In the past, the pipes were assembled by hand with the threaded ends being manually welded using stick electrodes. "But the pipes were breaking at the welded joints, which is a huge problem for the drilling process," says Mostert.

Yaskawa has now developed and shipped a dedicated robotic welding cell to produce the sound welds required and, since the trials started, breakages have stopped completely. "This system is therefore a huge benefit in terms of drilling downtime, and it delivers better manufacturing productivity and reduced costs," he adds.

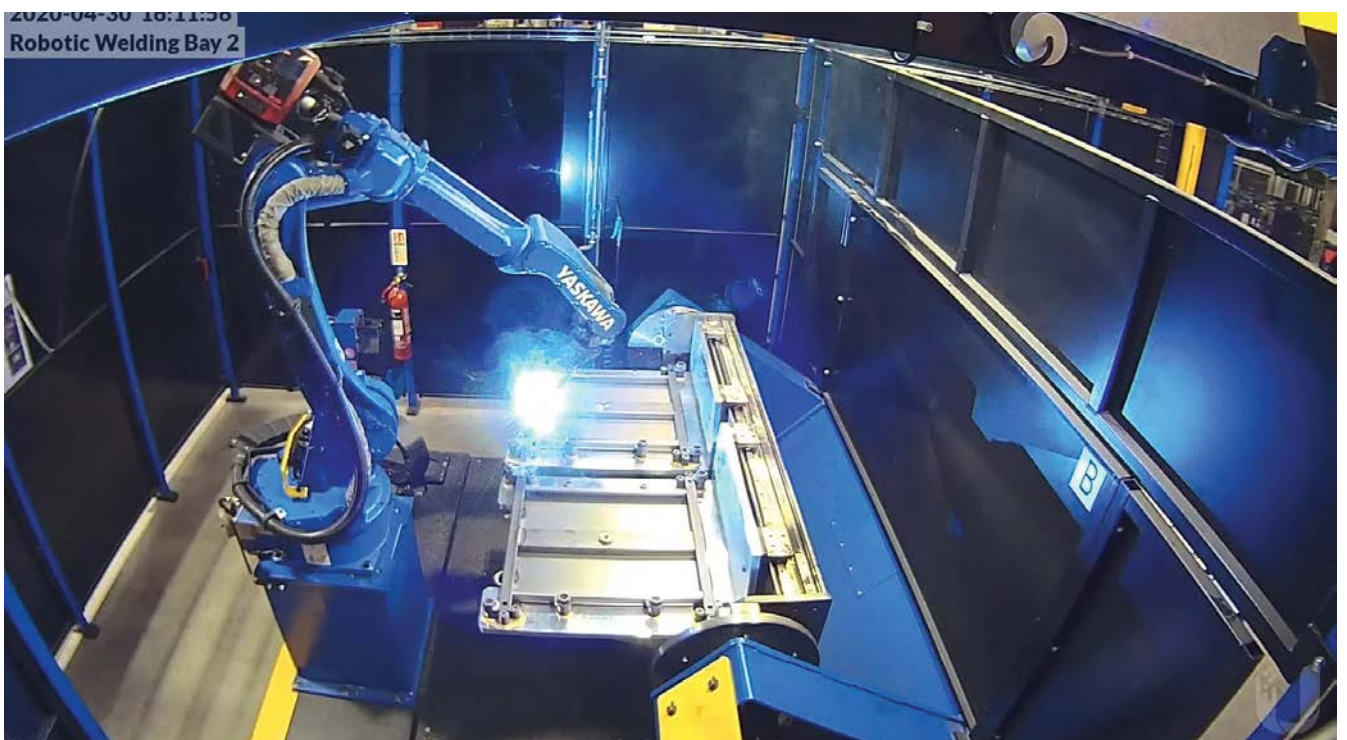
The robot cell has an AR2010 Yaskawa welding robot at its centre, coupled to a Fronius gas metal arc welding (GMAW) welding power source operating in synergic pulsed mode. The cell also has a pipe rotator on either side of the robot itself, so a

new pipe can be loaded on one side while another is being welded on the other.

"These pipes are assembled from CNC machined components with a male thread on one end and a female on the other. There is an inner ring on each end that first has to be welded into place to ensure the inner pipe remains straight during drilling. Then the assembly is hydraulically torqued up to 9 000 Nm prior to welding on the male and female threaded ends," Mostert tells *African Fusion*.

This cell has recently been shipped to Zambia to the customer's dedicated assembly facility and installation and training have now been scheduled.

Jan 't Hart adds another example in the mining industry, this time on the handling side for a manufacturer of underground rock bolts. "We are working with two companies called GRE Industries and Rocbolt, who make and supply fixing systems to stabilise the walls of underground mine tunnels. We have developed a number of different solutions for them, mostly for



An AR2010 Yaskawa welding robot for gas metal arc welding (GMAW), like the one being used to weld the drill pipes for a copper exploration company.



end-of-the-line type applications,” he notes.

Rocbolt products, he explains, are resin-based bolting solutions that consist of steel bolts up to 3.0 m long that are inserted into the walls and roof of a mine shaft, then bonded into the rock using resin.

The latest novel solution Yaskawa has put together for them is a robot system that uses two TP180 robots to pick up the manufactured bolts and strap them into bundles, before loading the bundles onto pallets. “We are also looking at using a SCARA SG650 robot for handling the washers that go onto the bolts. This robot will use a magnetic gripper to remove each washer from the eccentric forming press and place it on a stacking cell. From there, the washers will be linked with wire in batches of 5, 10 or 15.

“The idea is to change this whole end-of-line handling process into a high speed, error free application that will enable the productivity across the whole line to be increased,” notes ‘t Hart. “Long term, though, the plant will be automated wherever possible. So we are systematically adding robots to further raise production efficiency,” adds Mostert.

Also being negotiated is a development for Hydra-Arc in Secunda for a robotic system for refurbishing coal-to-gas gasifier components. “We are currently looking at resurfacing one of the high-wear nozzles for these gasifiers with a molybdenum-based material,” ‘t Hart reveals.

Yaskawa, he says, has been asked to put together a robot-based system to weld a 4.0 mm layer of material onto the inside surface of the nozzle of this gasifier. For this, Fronius low-dilution CMT (cold metal transfer) is being used, because the welding involves precise 5G pipe seams deposited around the inside of a 900 mm pipe. A welding torch with an 800 mm stem is therefore being used to ensure full access into the pipe nozzle without having to move the robot arm deep into the pipe.

“We have already done extensive testing,” continues Mostert. “The robot will enter the tube and do two 360° rotations, one in each direction, before coming out to be cleaned. We will continue to advance this process, two rotations at a time – until one full layer has been built up across the internal surface – being careful to systematically stagger the starting points.

“Testing is currently underway at our Longmeadow facility in Johannesburg, using the correct cladding material on a plain steel tube of the correct diameter. At the end of the day, the robot will be taken into the plant during a shutdown and placed in front of the gasifier nozzle to do the job,” Mostert explains, adding that he thinks two layers will typically be needed, depending on how much material has to be machined off prior to welding.

Currently, four gasifiers are being refurbished per annum, but the intention is to use two Yaskawa systems to refurbish 84 gasifiers over the next 10 years. “Currently, the whole nozzle is being cut out and fully replaced, which takes about 90 days per unit – and the loss of production cost for every gasifier out of service is around R2.5-million/day. In the long term, therefore, this system will deliver a huge cost saving,” ‘t Hart says.

Bottling rum in Mauritius

Going back to the handling side, ‘t Hart tells of Yaskawa South

GRE Industries and Rocbolt are looking at using SCARA SG650 robots to handle the washers that go onto the bolts.



A 3D CAD model of Yaskawa Southern Africa’s nozzle cladding system being developed for Hydra-Arc.

Africa’s first-ever venture into Mauritius, with a rum making company called Grays. The system Yaskawa is currently developing for them is for rum bottle recycling. Grays has a wash plant that processes about 1 800 recycled rum bottles every hour.

Six operators are currently emptying crates of used bottles from a stack and loading them onto a single-file conveyor. This is slow, repetitive work, and the company is looking for ways of making it more efficient.

“The robot handling system we have designed picks up a crate containing 12 bottles from the stack. It then deposits the crate onto one conveyor while keeping hold of the individual bottles. The empty crate is carried away, while each row of four bottles is then placed onto a single-file conveyor that takes them into the company’s wash plant,” he explains, adding that Yaskawa is also looking into modifying the conveyor so that all 12 bottles can be dropped at the same time to further reduce cycle times.

“This is the first robotic automation solution we will put into Mauritius and we are hoping it will open up new potential markets for us at other processing plants,” says ‘t Hart.

Concluding, he says that Yaskawa Southern Africa is seeing a lot more market share going towards palletising; pick-and-place and handling. “In the past, 80% of our business was motor industry and welding related. Today, up to 50% of our current business is for end-of-line applications.

However, for all applications to become globally competitive in terms of quality and productivity, interest in using robots continues to grow.

www.yaskawa.za.com

Renttech extends UNIARC range

African Fusion talks to Renttech's seasoned product manager, Johan Bester, about the latest additions to the company's UNIARC range of welding equipment, renowned for being ideal in harsh site conditions and for meeting the reliability demands of the African rental industry.

As well as having recently adopted two new premium brands – the Kemppi Brand of advanced welding machines and the voestalpine Böhler Welding consumables range – Renttech is also continuing to expand its range of UNIARC welding equipment, which has long been the mainstay of its rental and sales offering, most notably for onsite as well as factory use.

"We are on a mission to become the leading high-quality equipment supplier for engineering, welding, and fabrication companies across the country," says Johan Bester. "Each of our industrial sectors has its own unique welding equipment requirements, but all have an underlying focus on quality, performance and cost of ownership.

"UNIARC, part of the Renttech welding offering, has proven itself over the past 20 years as good value for money equipment that gets the job done, even in the most challenging conditions. As testament to this, UNIARC equipment can be found in most workshops in South Africa as well as on most construction or maintenance sites around the country, Bester contin-

ues. "Renttech continually invests in and improves this product line as we believe it is a critical offering for South African industry. This can be seen in our newly adopted tagline on the UNIARC logo: Keep Evolving.

"Welding technologies are constantly improving, and we need to be able to offer up-to-date welding solutions that enable our customers to be competitive within their respective industries."

The UNIARC range has grown to include welding equipment, ranging from stick to submerged arc solutions, handheld and automated plasma cutting solutions, engine driven welding solutions, handheld laser welding solutions, as well as hard automated solutions such as column and booms, rotators and manipulators.

Bester cites two existing product ranges that have been in South Africa for the past two years, which offer "excellent value for money" as well as a "host of new features that makes these excellent choices for modern fabricators or maintenance crews".

UNIARC NOMAD engine drives

Extending the UNIARC range of engine-



Renttech's recently released 200 A, single-phase, multi-process, 'expert' system, the UNIARC Multi 201 XPRT, offers high-end MIG/GMAW/FCAW processes, including conventional, pulse and double pulse GMAW options; as well as dc TIG and pulsed dc TIG with touch and high frequency starting.

driven welding systems for remote onsite use, Renttech recently released two new products under the UNIARC NOMAD range. "First, the NOMAD 300S is a 300 amp single arc version and second the NOMAD 400DUAL, is a 400 amp dual arc system, meaning you can weld using a single arc and have two welders welding simultane-



The NOMAD 300S (left) is a 300 A single arc, Kubota engine driven welding system, while the NOMAD 400DUAL (right), with the same engine, is a 400 A dual arc system that can be used by two welders welding simultaneously.

ously,” Bester tells *African Fusion*.

The NOMAD300s is a cc/cv multi-process welding system powered by a Kubota engine and built for the construction, pipeline and mining industries. This 320 A unit offers excellent weld performance in stick mode with arc settings available for common electrodes such as E6013, low hydrogen electrodes such as E7018-1, or stainless-steel electrodes. There is also a special pipe mode for cellulosic electrodes, which are typically used in the water pipeline sector.

Should a welder need to do TIG welding, he or she can choose between traditional scratch start TIG – still favoured by many process pipe welders – or lift start TIG, which reduces the risk of tungsten inclusions in weld starts. “For wire processes such as MIG welding or flux-cored welding, we also offer the UNIFEED 24 voltage sensing suitcase wire feeder, made from hard wearing plastic composite, that you can connect to the NOMAD range for those projects requiring the use of higher deposition processes – such as storage tank fabrication or overland pipelines. On the auxiliary side, the NOMAD 300S also offers two single-phase 230 V auxiliary outputs for supplementary activities such as grinding or lighting,” he adds.

One step above the NOMAD 300S is the NOMAD 400 dual, which offers a dual arc welding system driven off a slightly stronger Kubota powerplant. “Our NOMAD 400Dual offers all the features and processes of the Nomad 300S machines, with a few additional features. You can choose to weld with a single arc at current levels of up to 400 A. Should you wish to run two arcs you have 210 A available per arc to use as you see fit. This does not necessarily have to be two stick welding arcs, but can be any combination of processes.

“For example: if welder one is required to do tack welding using sticks, and welder two is required to do a root pass on a pipe using TIG welding, both these processes can be used at the same time without any interference between the two arcs. This is made possible by unique coil winding technology,” Johan Bester tells *African Fusion*.

In addition to the two single phase auxiliary outlets, the dual unit also gives access to a 380 V three-phase outlet for non-welding work.

Smart engine controls, including a brushless alternator in both models, ensures excellent fuel efficiency as well as reduced yearly maintenance costs. The NOMAD range also offers industry leading sound levels of only 65 dB at just 7.0 m away, making the working environment more comfortable and improving construc-

tion team communication. Both units come standard with a VRD – voltage reduction device – to meet safety regulations for welding equipment used in the SA mining industry; and the unit is covered by a three-year warranty on parts and labour for the embedded welding equipment and a standard 1-year Kubota warranty on the engine.

“With more than 200 models in active use in the broader Southern Africa region for applications including pipelines, mining projects, construction projects, petrochemical shutdowns, railway maintenance, as well as power generation maintenance programmes, these units have proven their reliability and popularity with many contractors, who ask for it by name, whether to extend their fleet, or to rent from us for their short-term projects,” Bester notes.

The UNIARC Multi 201 XPRT

“On the other end of the spectrum, we recently released a modern, 200 A, single-phase, multi-process, ‘expert’ system: the Multi 201 XPRT. This system offers high end MIG/GMAW/FCAW processes, including conventional, pulse and double pulse GMAW options as well as DC TIG and pulsed DC TIG with touch, and high frequency starting options,” Bester continues. Also included are SMAW/STICK/MMA process options, including conventional and synergic SMAW for rutile, stainless steel, basic and cellulosic electrodes.

“The Multi201 XPRT is a serious industrial 220 V single-phase compact welding system. It offers flexibility and mobility, across the weld processes, with all the features and welding arc controls demanded by welding professionals. Dial in your weld according to material grade, plate thickness, welding process, and shielding gas and you are ready to weld.

“One of the highlights of this machine is the addition of high-frequency TIG, making the system suitable for industrial maintenance and repairs in tough environments such as power stations, offshore platforms, shipbuilding and petrochemical sites, to name a few. These sites have a lot of hard-to-reach piping that is welded mostly with HF TIG. Yet, there are other applications on the same site that must be welded using wire or stick processes. All these processes are included in the machine,” he tells *African Fusion*.

Another benefit is the addition of pulsed MIG as well as flux cored programs that



For wire processes such as MIG welding or flux-cored welding, Renttech supplies its NOMAD range with the UNIARC UNIFEED 24 voltage sensing suitcase wire feeder.

redefine the material thickness range that can be welded from a 220 V single-phase unit without the risk of cold lapping or lack of penetration. “Normal CV MIG seen in conventional 220 V machines just doesn’t have enough amps to weld thicker materials. These welds are normally reserved for 3-Phase, 380 V machines. The pulse and flux cored programs remove this restriction and open a whole spectrum of applications and thicknesses that can now be welded with a 220 V system,” Bester assures.

“The tough LED touch screen display and knobs, designed for easy adjustment even in low light conditions, make it a breeze to dial in your weld setting. The intuitive user interface guides you through all the important parameters and is shown on the main screen for easy access and navigation,” he adds.

There are also 100 memory locations for saving weld settings, and a digital keyboard to make it easy to name an ideal weld setting for easy identification and retrieval. The machine is equipped with a digital welding torch to allow the welder to adjust weld parameters from the torch, and the welding machine can be powered from a welding generator – typically a requirement for site conditions.

Electra Mining Africa

“All these new UNIARC solutions will be on show at our Electra Mining Africa Stand from 2 to 6 September 2024 at the Nasrec Exhibition Centre in Johannesburg. We will be doing live demonstrations across our whole range of products, including the new Kemppi machines, which we will be coupling with our new voestalpine Böhler Welding consumables. Please visit us in the Yellow Zone, Stand P75,” concludes Johan Bester.

<https://renttechsa.co.za>

Thermamax TITAN adjustable solar helmets

The new innovative range of Thermamax TITAN helmets with auto-darkening filters (ADFs) enables welders to take control of their welding experience by selecting the ADF that best aligns with their needs and preferences.

Within the realm of metal craftsmen, welders are widely regarded as a premier athletes. Their profession demands resilience in the face of harsh working conditions, including exposure to fumes, constantly shifting levels of brightness and intense heat. Furthermore, welders bear a significant level of responsibility as a defective welding seam could potentially lead to catastrophic, and even fatal, accidents in extreme circumstances. This combination of physical and mental demands sets welders apart as exceptional individuals within the fabrication field.

Investing in a high-quality welding helmet is an investment in both the present and the future. It ensures that every weld is done with precision and care, while safeguarding the welder's well-being. A high-quality welding helmet increases efficiency, accuracy and overall comfort. From protecting against harmful rays to providing clear visibility, a top-quality welding helmet is a non-negotiable necessity in the world of welding, where there is no room for compromise, and only the best will do.

What sets the Thermamax TITAN range apart is that it offers users the ability to choose between two auto darkening filters (ADFs), either the DIAMOND ADF or the

ONYX ADF, providing flexibility and customisation based on individual preferences, prioritising clarity or versatility respectively.

This level of customisation ensures that users can optimise their experiences based on their unique requirements.

The DIAMOND ADF is designed to offer exceptional clarity and visibility, ensuring that users have a clear view of their work at all times. On the other hand, the ONYX ADF is known for its reliability and versatility, catering to a wide range of welding applications.

The TITAN Diamond

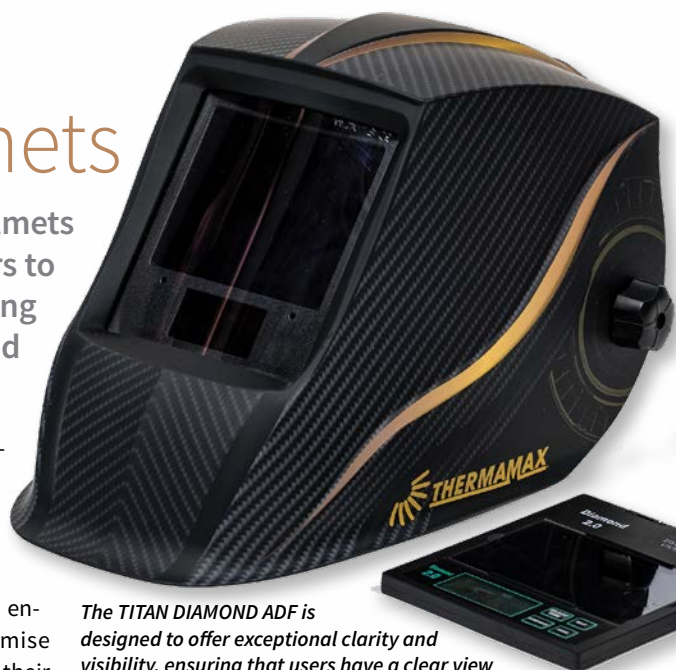
The new Tru-Vision Colour Technology built into the Titan Diamond ADF revolutionises the welding experience by providing welders with unparalleled clarity and visibility. With an astounding light transmission in bright conditions, welders can now work with a practically unclouded and clear view of their working environments, offering insights at a new dimension.

This level of clarity allows welders to see the joining process as it takes place, from the melting of the weld pool to the creation

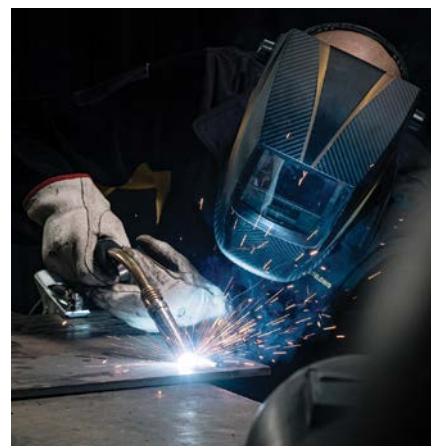
of the weld seam. The almost perfect colour spectrum of the Diamond ADF enables welders to have complete control over their work, with the ability to see how the filler material is melting into the welding pool.

Superior visibility before and during welding is essential for ensuring safety at work. By having a clear view of the work area, welders can better anticipate potential hazards and take necessary precautions to avoid accidents. In addition, superior visibility allows for more precise and accurate welding, resulting in higher quality workmanship and ultimately creating a safer and more productive work environment.

The sensitivity adjustment feature ensures that the right protection level is always maintained, offering vision and clarity. In light mode, the colour perception is akin to looking through clear window glass, while in dark mode, welders can enjoy a de-



The TITAN DIAMOND ADF is designed to offer exceptional clarity and visibility, ensuring that users have a clear view of their work at all times.



Thermamax TITAN helmets with auto-darkening filters (ADFs) are able to automatically adjust the sensitivity level to set the right level of protection. Left/Above: TIG welding; Left/Above: MIG/MAG welding.



The Thermamax TITAN Helmet Range has an adjustable dual-strap comfort system with a torque ratchet and comfort band to ensure a secure and personalised fit for each user.



The included Speedy Loop hard hat adaptor enables wearers to attach a hard hat to their helmets.

tailed and high-contrast view of the welding pool with unprecedented clarity. With a protection level of 2.0 in its light state, the TITAN Diamond ADF allows welders to see their working environment as if they were not wearing an auto-darkening lens at all.

Key features of the Diamond ADF include:

- Unprecedented 2.0 Clear Light State thanks to its TruVision Technology.
- Digital dark state of 5-8/9-13.
- Overall ADF range of 4 to 13.
- 1/1/1/2 classification to ensure eyes are protected from all harmful UV and IR emissions.
- Multiple certifications, including ANSI Z97.1-2015; EN 175:1997; CSA Z94.3-2015; and CE EN 379:2009-07.

The TITAN Onyx ADF

The TITAN Onyx ADF utilises an adaptive shade level sensitivity adjustment, which automatically sets the optimal shade level between 5 and 13. This feature ensures that eyes are always protected while welding, as it continuously adjusts to the appropriate shade level based on the intensity of the welding arc.

With the inclusion of an additional brightness sensor, any changes in arc intensity are immediately detected and the shade level is adjusted accordingly. This means that manual adjustment is no longer necessary, providing a seamless and hassle-free welding experience. This advanced technology guarantees that welders remain perfectly protected at all times, regardless of the specific welding parameters being used.

Features of the TITAN Onyx include:

- 4.0 clear light state.
- Digital dark state of 5-8 / 9-13.

- Overall ADF range of 4 to 13 for maximum UV and IR emission protection.
- 1/1/1/2 classification.
- Certifications including DIN EN 379:2009-07 and CE EN 379:2009-07.
- Automatic power-on function thanks to its photosensitive sensor on the filter lens. It is thus able to sense changes in light and will automatically power on. When it senses an absence of light stimulation, it will automatically power-off after 10 minutes, saving battery life.

Sensitivity adjustment control

The sensitivity adjustment control found in both ADFs automatically sets the right protection level within a range of 4 to 12, ensuring users are always protected. This

is made possible by an additional brightness sensor that measures the intensity of the welding arc. With this feature, manual adjustments are no longer needed, as the ADFs will take care of setting the appropriate protection level

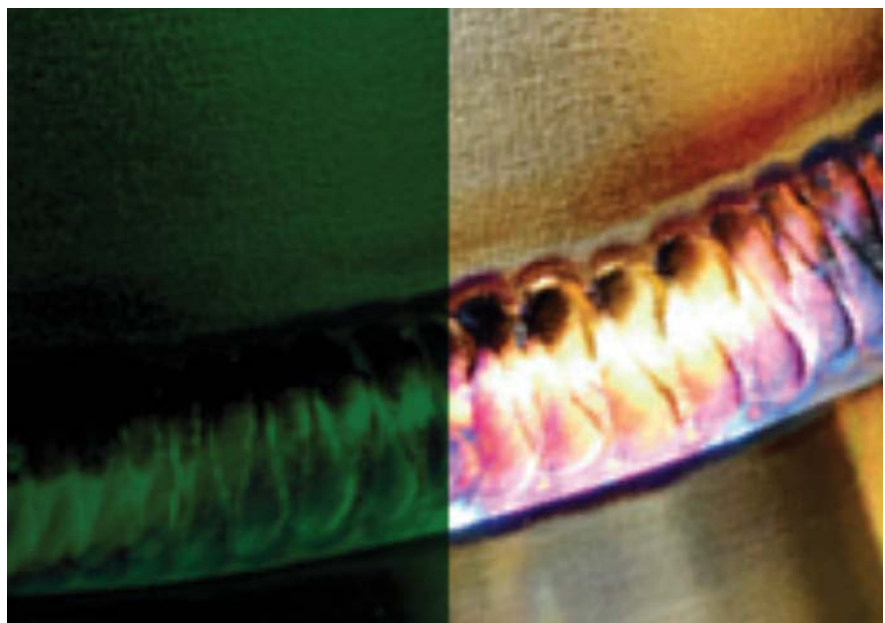
This means that no matter what welding parameters are being used, welders can have peace of mind. The adaptive control system simplifies the welding process, allowing welders to focus on the task at hand without having to adjust protection levels constantly.

The Thermamax TITAN Helmet Range prioritises comfort above all else, making it one of the most comfortable welding helmets available. Its superior dual-strap adjustable comfort headgear with torque ratchet and comfort band ensures a secure and personalised fit for each user. Additionally, the Speedy Loop hard hat adaptor enables the wearer to attach a hard hat to the helmet, allowing for simultaneous use of both items.

Despite its advanced features, this helmet remains lightweight, reducing strain on the wearer during extended use. Furthermore, it offers a convenient Grind Mode, eliminating the need to switch between helmets for different tasks.

To provide added peace of mind, the Thermamax TITAN Helmet comes with a 12-month warranty, ensuring long-term satisfaction and protection for the user. With its focus on comfort, versatility, and durability, this helmet is the ideal top choice for welders seeking a reliable and user-friendly protective solution.

<https://uniquewelding.co.za/>



A comparison of dark and light modes of the Titan Diamond: In dark mode (left), welders can enjoy a detailed and high-contrast view of the weld pool with unprecedented clarity, while in light mode, the colour perception is akin to looking through clear window glass.

Welding automation for overlay cladding

Fronius's retrofittable SpeedClad 2.0 overlay cladding system won the Excellence in Welding Award at the American Welding Society's 2023 FABTECH show in Chicago. Anton Leithenmair, head of Fronius Welding Automation, and Siegfried Wiesinger, a global overlay welding expert, outline the company's automation capability.

As well as being a global leader in the manufacture and supply of advanced welding power sources and associated process control innovation, Fronius Welding Automation also develops and installs customised welding automation solutions from the start of an enquiry, through the development and start up phases and throughout the entire service life of the welding system. And, thanks to updated options and retrofits, Fronius customers anywhere in the world can now access additional benefits from the company's latest overlay welding and other automation solutions.

Realistic welding tests and feasibility studies

Every new overlay welding project at Fronius Welding Automation begins with feasibility studies and welding tests, notes Anton Leithenmair, head of Fronius Welding Automation. Overlay welding is a highly complex process. In addition to the base material of the components to be surfaced, parameters such as amperage, wire speed, welding speed, filler metal, shielding gas, ambient temperature and humidity also

play a critical role, he says.

Even minor deviations can have unwanted effects on the welding result. This is why welding tests should be as realistic as possible—with components, filler metals and shielding gases that will be used when the system goes into live operation. If possible, the tests should also be carried out under the same climatic conditions that prevail at the intended place of use.

"We need an open, trusting exchange of information from the outset to ensure that overlay welding systems are customised to customer requirements. Are there any specifications regarding the filler metal and shielding gas? What about the local climatic conditions? One particularly important factor is being able to carry out our welding tests with original components rather than resorting to using mock-ups. This is the only way our systems can deliver the desired welding results, even under the harsh conditions of continuous operation," argues Leithenmair.

Over a period of more than forty years, Fronius has developed application-based overlay welding systems that are either used as standard or modified to meet spe-



cial customer requirements, most notably for the global oil and gas industry.

Leithenmair highlights Fronius' Compact Cladding Cell (CCC), which has a typical footprint of 6.0 m² mounted on a transportable platform. "The Fronius CCC is a compact solution for overlay welding, developed as a cost-effective internal cladding solution for valve components with a maximum bore/depth and component diameter of 1.0 m and a total component weight capacity of 2 500 kg," he says.

This powerful system stands out for its ease of use, precise positioning and sequencing, and its comprehensive range of data recording options. The ergonomic design includes a wire spool holder at a comfortable user height, a welding torch with a quick-change system, and Fronius power sources on rails.

The CCC also boasts innovative software functions, maximum process security and ultimate reliability in continuous operation. The HMI interface offers next-level ease of use with a 21-inch touch display, real-time process visualisation, multi-user management, and more.

Fronius SpeedClad 2.0

For overlay welding applications of valve components requiring the highest possible productivity, Fronius' SpeedClad 2.0 hot-wire TIG is recommended, being faster, resource efficient and more economical than the traditional hot-wire TIG processes. This innovation stands apart thanks to its high deposition rate, impressive speed, and low shielding gas consumption. In recognition of these exceptional results, the process was awarded the Excellence in Welding Award by the American Welding



Siegfried Wiesinger programs the system using the HMI-T21 system controls.



Above: Fronius' tilting positioner with an ETR (Endless Torch Rotation System) offers unlimited rotation and positioning of the welding head.

Left: Fronius' Compact Cladding Cell (CCC) with rotating positioner, HMI-T21 system and remote control.

Society at FABTECH in Chicago on September 13, 2023.

The judges were impressed by the high deposition rate of the nickel-based alloy being used for overlay welding, which was increased from 1.63 to 6.0 kg/h, with Fronius now using a 1.6 mm wire in place of the 1.2 mm wire. The welding speed was raised from 33 cm/min to 135 cm/min, and the average pulsed current went from 240 A to 460 A.

With this process, Fronius customers can use the ideal heat input – heat input=VI/welding speed – as the starting point for optimising the welding parameters and speed. Also, argon gas consumption can be reduced from 516 l/kg to as little as 140 l/kg and the re-developed welding torch allows cladding in components with significantly narrower diameters, down to 100 mm from 150 mm.

The key features of a SpeedClad 2 system include:

Fronius' Endless Torch Rotation (ETR) system: The ETR's endlessly rotating welding head makes it possible to continuously weld components with different bores and bore angles with internal diameters of up to 1.0 m. The welding torch and the wire feeder rotate together around the bore axis. Components are centred automatically, which shortens set-up times considerably and saves production costs. And if there is any risk of the torch colliding with the component, the electropneumatic collision detection system stops all axes of movement and protects the welding torch against damage.

Fronius recently enhanced the ETR system with an even more flexible ETR Ultimate torch. In addition to overlay welding tasks, this versatile system now makes

it possible to join larger components with challenging geometries and difficult seams. As with the Compact Cladding Cell, both the ETR and ETR Ultimate systems come with system controls accessible via a convenient 21-inch touch display, which offers real-time process visualisation and multi-user management as standard.

Where necessary, the ETR or ETR Ultimate welding torch and the positioner move in sync, to enable the SpeedClad 2.0 to deliver maximum productivity.

All parameters live and at a glance: The HMI-T21 system controls used for the SpeedClad 2.0 are Industry 4.0-ready with a large, intuitive 21-inch touchscreen, multi-user accounts with individually assigned authorisations, process visualisation in real time, on-the-fly parameter adjustments, and innovative functions such as X-Ray View, Component Editor, Bore-to-Bore Advanced, actual value monitoring in real time, and STEP file import.

The system also offers remote maintenance capabilities. The X-Ray view provides a transparent outline of the component to give the operator an excellent overview. The Bore-to-Bore-Advanced function offers assistance when several offset transverse bores with non-90° angles, or flanges with bores have to be clad. And all relevant welding parameters are displayed live using system-integrated actual value monitoring.

A solution for every need: Welding operators can create components step by step in the Component Editor via the HMI-T21 touchscreen. The height and diameter are defined by inputting the relevant dimensions, and the various components appear in real time as 3D graphics on the screen. In addition to cylindrical shapes, flat and conical shapes are also possible. There

are also options to model bores and extensions, such as flanges. The CNC technology now integrated into Fronius' automation systems creates scope for even more component geometries than before, including intersection bores on conical components.

The welding processes are programmed in the Program Editor. Operators select the individual sections of the components and define the welding sequence. One especially helpful aspect is that the welding torch can be shown at the starting point.

The system offers a selection of jobs with fixed parameters that can be adjusted at any time—even on-the-fly—in the Weld Adjust menu. AVR (Actual Value Recording) records the values of the welding current, voltage, wire speed, gas consumption and welding position during the welding processes – in tabular form. The PC software packages, Data Logger HMI and Data Viewer HMI are optionally available for graphical evaluations and analyses.

Once the home position of the welding torch has been calibrated, the torch moves independently to its starting point for each overlay welding application, explains Siegfried Wiesinger, overlay welding expert at Fronius. "The remote control can be used to fine-tune a range of parameters even just before igniting the arc. For example, the AVC (Arc Voltage Control) function adjusts the starting point and distance of the welding torch to the component," he adds.

Seam and robotic welding systems

As a solution provider, Fronius Welding Automation produces mechanised and robotic welding systems for industrial fabrication tasks. These include longitudinal and circumferential seam welding systems, welding carriages and robotic handling-to-welding systems.

Collaborative systems, intelligent sensor technology, software solutions for data management, and offline programming and welding simulation open up profitable welding opportunities for metal processing companies, starting from a single batch. We are able to analyse specific requirements for the welding system with customers, and this is followed by the creation of a unique customised solution," continues Anton Leithenmair. Since 1975, more than 3 500 Fronius systems have been installed and used across 45 countries by over 2 000 customers, he notes.

The Fronius team is looking forward to showing these innovations at the ADIPEC trade show in Abu Dhabi, on 4th to 7th of November 2024, Hall 14, Stand 14316.

www.fronius.com

Courses Credited by:



Cosmo Training Academy **WELDING COURSES**

1

Welding Machine Training

One (1) day training, of all possible settings of your machine as well as the set-up and safe usage of your machine when you buy a welding machine at Cosmo Industrial.

2

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3

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5

International Welder Diploma (IIW)

Duration includes ten (10) days theory and a minimum of three (3) weeks practical.

It consists of theoretical as well as practical training in all FOUR (4) different welding processes.

6

QCTO - Quality Council for Trades & Occupation Welder

Three (3) year full apprenticeship, leading to Trade test. Nine (9) months training at Cosmo Training Academy.

7

SAARPL Trade Test

Twenty (20) day Welding Trade Test Preparation.

Welder must have three (3) years or more work experience.

This course will prepare you before writing the Trade Test.

Cosmo's WELDYCAR with SPEEDTEC solution

African Fusion talks to Petrus Pretorius about a successful Cosmo-developed and demonstrated welding solution for the fabrication of truck bodies, which involves the combination of Lincoln Electric's WELDYCAR magnetic portable welding carriage for MIG/MAG welding, with the company's next-generation SPEEDTEC® welding system.

The Cosmo Group was recently asked to assist a local truck body manufacturer to improve its weld quality and consistency for the manufacture of flatbed trailers. "The fabrication of these trailers was all being done by hand, using the conventional CV MIG/MAG welding process, which was resulting in inconsistent weld quality and a lot of spatter," Petrus Pretorius tells *African Fusion*.

"The requirement involved welding plate seams to form the bed of the trailer using continuous weld runs of up to 6.0 m long in the down-hand position. Almost all of the welding involved plate-to-plate butt or lap welds in the down-hand positions," Pretorius continues.

"At the starting point of developing a solution, we decided to use synergic pulse MIG/MAG welding to significantly reduce the spatter levels. The second key idea was to use a semi-automated welding carriage to deliver bead consistency and a near-finished surface quality," Pretorius tells *African Fusion*, adding that the latest generation SPEEDTEC 500SP from Lincoln Electric, along with new Lincoln Electric WELDYCAR compact, magnetic and battery operated welding carriage, was found to be the ideal combination for this task.

"Welding by hand involves a lot of stop/starts, and not many welders can maintain the precise travel speed needed to produce accurate seam widths and surface finishes. So our solution was able to deliver a lot of positives," he notes. "A synergic pulse programme was selected for a 1.0 mm carbon steel welding wire and an average current of between 160 and 180 A was found to be ideal," he adds.

To enable continuous welding, Cosmo Group chose to use the advanced LF56D wire feeder, which comes with the new high-efficiency COOLARC® 60 water cooler with a 4-wheel cart to enable the feeder to be moved easily while welding progresses. "This unit has a solid metal construction and a wide range of long connection cable

and accessories to make longer welding lengths possible," Pretorius notes.

Describing the use of the WELDYCAR, he says Lincoln Electric has developed a set of guiding systems, including a built-in magnetic system, that eliminate the need to continuously adjust the carriage position whilst welding. "We were able to use a fence-like guiding system, with contact rollers running along the edge of the truck body to keep the torch aligned to the rollers. Also available, though, is a magnetic track guiding system, which is easy to set up and move to the next weld seam," he explains.

Battery operated with a six hour continuous use battery life; the whole carriage weighs just 12 kg. Additional features include: a tilting torch holder; linear and pendular oscillators; arc protection; and robust aluminium wheels. "The weaving capability makes the WELDYCAR ideal for vertical up welding, which is often difficult for welders to get right," suggests Petrus Pretorius.

No separate programming device is required and the system is seamlessly compatible with Lincoln Electric's LF56D wire feeder and the SPEEDTEC power source. Most notably, Pretorius says that the system uses the arc voltage to sense when the arc has been struck so it starts to move at exactly the right time. Start and stop sequences, linked to the wire feed and power source parameters, can also be set to optimise weld start and stop geometries.

Turning attention back to the results, Pretorius shows a video of the demonstration in progress and a photo of one of the seams. Not only is there no spatter, but the finished weld seam is smooth with a consistent width. "The client was pleased and we are continuing to work with them and their welders to help improve weld quality at the facility.



For WELDYCAR, Lincoln Electric has developed a set of magnetic and other guiding systems that eliminate the need to continuously adjust the carriage position while welding.



The advanced Lincoln Electric LF56D wire feeder, with its high-efficiency COOLARC® 60 water cooler, was chosen to ensure continuous welding.



The finished weld seam is smooth with a consistent width and little spatter on the surrounding surfaces.

"As skilled quality welders become more and more scarce in the manufacturing industry and expectations around efficiency and productivity continue to be raised, the WELDYCAR system, along with Lincoln Electric's newest generation multiprocessor machines, are sure to help any fabricator to better meet customer expectations," Pretorius concludes.

cosmogroups.co.za

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Cousins: strong steel succession and synergy

In South Africa's dynamic and frequently volatile steel sector, succession planning and the creation of robust synergies are often the exception to the rule, but dynamic structural steel company Cousins Steel International (CSI) demonstrates that these can indeed be successful and enduring.

Cousins Steel International (CSI), which adeptly blends its decades-old legacy with modern steel technology and insights, is very proud of its roots and track record, and equally, of its current synergies which are energising and driving the business forward.

Cousins Steel CC, a 55-year-old fabrication company located in Pietermaritzburg was started by brothers Lynton and Craig Cousins. Highly experienced structural steel fabricators and well-connected, savvy businesspeople, the brothers grew their business into a respected large-scale fabrication facility with a sound reputation.

Meanwhile in Durban, professional engineer, Mike Oldfield, had opened his own business on the Berea, specialising in residential, commercial and industrial projects and building his own very successful civil and structural engineering practice, completing many successful projects.

Oldfield began exporting steel structures into Africa in the early 2000s, and numerous distinctive structural steel projects, from prawn farms to mines, followed, predominantly in Madagascar.

A long-standing relationship with the Cousins brothers saw Oldfield outsource the fabrication of the more than 2 000 steel structures to the Pietermaritzburg-based operation from 2001 onwards, bound mostly for the Madagascar ammonia sulphate mines. This mutually beneficial relationship culminated in a joint venture for the Madagascar and other pan-African export projects, known as Cousins Steel International (CSI), in 2001. The latter acted as a design office, with the fabrication taking place at Cousins Steel CC's Mkondeni facility.

In the ensuing years, the volatile political climate in Madagascar meant that CSI shifted its market focus to the local design supply sector, which was gathering momentum. Then Adam Oldfield, who had followed in his father, Mike's, structural engineering footsteps, joined CSI and went on to become a company director.

The CSI-Cousins Steel CC relationship

and collaboration prospered for a further 20 years, until Lynton and Craig Cousins stopped fabricating in 2021. "As CSI, we had to make some tough decisions. Should we find another fabrication partner or – in a somewhat revolutionary move at the time – should we take on the challenge of fabricating in-house ourselves?" Adam Oldfield recalls.

Backed by all he had learnt from his father's effectiveness on-site and his practical, inclusive approach to all disciplines involved in structural steel projects, but taking into account that he was wanting to retire, the Oldfields had to decide quickly if he had the energy to take over the reins at CSI with a new fabrication arm and to introduce a whole new element of the business into the mix.

"We decided to go for it and immediately began making calls, as there was no time to waste! We struck a deal with Lynton and Craig to purchase their surplus steel, vehicles and fabrication equipment, but not the CC itself," he adds.

Looking around for larger premises, in 2021 Oldfield found what he describes as the 'perfect structural steel facility' in Mount Edgecombe Industrial Park: "We had constructed a number of buildings there, and were told that one of the tenants was in business rescue and would be vacating a facility that was ideal for steel fabrication," he recalls.

In a case of 'steel serendipity', CSI relocated to the facility, and undertook the monumental task of moving all the ex-Cousins Steel CC fabrication equipment to the new facility in Mount Edgecombe, where they currently operate from, having recently signed a second lease.

Although Cousins Steel CC closed when the brothers retired, its proud steel fabrication legacy lives on in Cousins Steel International, which has innovatively combined design, engineering, fabrication and supply into a strong steel synergy, while remaining true to its safety, quality and client service ethos.



International's (CSI) steel fabrication facility in Old Mill Industrial Park, KZN.

"We worked hard to consolidate fabrication into CSI's operations, and to proactively market the company and reassure the structural steel sector that Cousins Steel International was very much still in operation," Oldfield emphasises. In just three short years, he and his team have built up an enviable track record of structural steel project delivery, including several award-winning projects extending from Riverhorse Valley to Phoenix and the Dube TradePort, which is expected to grow into the R1-trillion Durban Aerotropolis.

Currently, CSI is putting its stamp on Brickworks, Durban's most recent industrial park, recently completing a 40 000 m² superstructure that will feature in this year's SAISC Steel Awards.

Oldfield leads the company with seasoned fabrication and steel industry professionals at his side: CSI's factory manager, experienced fabricator Lee-Roy Britz, and well-known steel industry stalwart Gordon McNeill, who has been in the sector for over 50 years, starting in Ireland at the age of 16.

"Lee-Roy was a natural first choice. He is a meticulous fabricator and is doing what he loves. We have a wonderful synergy and blend of competencies, experience and personalities. This is built on a solid foundation of trust and, because of their experience, I am always willing to receive their input and guidance," says Oldfield.

With this strong management team in place, and his now-retired father available to consult if required, Oldfield is excited about CSI's prospects, and is confidently looking to the future. "We are proud to be a company where engineering and design do not reside in an 'ivory tower' separated from the realities of every day structural steel construction, but rather, prosper at ground- and project-level, alongside fabrication," Oldfield concludes.

<https://cousinssteel.co.za>

B.E.D. Klerksdorp and Consulmet Construction build partnership

Consulmet Construction, a leading name in the steel fabrication sector, has entrusted B.E.D. Klerksdorp with its cutting and welding equipment requirements, opting for the company's expertise and quality solutions, over those of other potential vendors.

"Our partnership with Consulmet Construction has flourished as the company has grown. We introduced Consulmet Construction's MD, Martin Rautenbach, to the latest GYS CO₂/MIG/MAG welding machines two years ago, and the company made its first purchase shortly thereafter. With our local presence in Klerksdorp, Martin gained confidence in our ability to provide timeous supply and exceptional customer service, as well as the all-important after-sales support," says Ian Lloyd, operations manager at B.E.D. in Klerksdorp

Dwayne Kriek, procurement manager at Consulmet Construction agrees: "As a steel fabrication company, optimising productivity while minimising downtime is crucial for our sustained profitability. The GYS welding range has proven to be instrumental in mitigating machine breakdowns, thereby enhancing our production efficiency and profitability. The robustness and reliability of these products justifies the investment. Efficiency ensures productivity, and with GYS machines, we achieve this consistently."

However, the relationship between

the two companies is more than merely transactional: it is about trust and understanding. Sean Christian, B.E.D. Welding & Cutting Specialist, emphasises the significance of this bond: "People buy from people. Consulmet Construction's production line operates under extreme pressure, demanding high levels of efficiency and reliability. Our close relationship with this valued customer – coupled with the superior speed and quality of our welding equipment – made B.E.D. the natural choice for Consulmet Construction."

Consulmet Construction's Lloyd continues: "We tailor our solutions based on the applications and desired outcomes of our customers. Our range of equipment, including the MAGYS 400, PROMIG 400, and GYSMI 200 inverters and Hypertherm XPR 170 plasma cutting unit, offer unparalleled reliability and performance – all of which are ideal for Consulmet Construction's steel fabrication requirements."

B.E.D. Klerksdorp recommended this equipment to Consulmet Construction based on a thorough assessment of their particular requirements, challenges and operational environment.

"Understanding fabricators' applications and objectives was paramount. With a focus on steel fabrication, the welding equipment and consumables we supplied needed to be versatile enough to handle a variety of metal materials and thicknesses



Dwayne Kriek of Consulmet Construction and Ian Lloyd of B.E.D. Klerksdorp with GYS welding equipment provided by B.E.D.

commonly encountered in the company's projects," Lloyd advises.

He adds that durability and reliability were essential criteria, especially considering the demanding nature of the construction industry, with its tight deadlines and focus on minimising downtime as far as possible.

"We recognised that this customer could certainly not afford lengthy interruptions to its workflow due to equipment failures," he concludes.

<https://bolteng.co.za>



Integrity NDT Projects, a member company of Two Roads Group, recently hosted a delegation of VUT students to cultivate future professionals in the critical field of Non-Destructive Testing (NDT).

Integrity NDT Projects Hosts VUT Students

Further solidifying the collaborative spirit established through the December 2023 Memorandum of Understanding (MOU) between Two Roads Group and the Vaal University of Technology (VUT), Integrity NDT Projects, a member company of Two Roads Group, recently hosted a delegation of VUT students.

This initiative aligns seamlessly with the MOU's core objective of cultivating future professionals in the critical field of Non-Destructive Testing (NDT). The meticulously designed programme provided VUT students with a comprehensive understanding of the essential role NDT plays in safeguarding the integrity and reliability of infrastructure, with a particular focus on South Africa's power generation sector.

The programme embarked on a comprehensive exploration of NDT, encompassing a multitude of topics such as:

- Fundamentals of NDT and Significance in the Power Industry.
- Implementation Strategies of NDT at Power Plants.
- Examination of NDT Processes and Methodologies: including Ultrasonic/Wall Thickness Testing; Positive Material Identification (PMI); Dye Penetrant Testing (PT); Magnetic Particle Testing (MT); Phased Array UT PAUT); Portable Hardness Testing; and Radiographic Testing (RT)

Kabelo Molaudzi, Key Accounts Executive at Integrity NDT Projects, said: "We were delighted to welcome VUT students to our facility and share our knowledge of NDT. This was a valuable opportunity to showcase the practical applications of NDT and ignite a passion for this field in the upcoming generation of NDT professionals."

www.integrityndt.com



Dekra Institute of Learning: embraces QCTO training

The Dekra Institute of Learning (IOL), a leading adult-based education and occupational skills training provider, has achieved a groundbreaking milestone by achieving Quality Council for Trades and Occupations (QCTO) accreditation for First Aid training.

Christopher Mörsner, Head of Training and Consulting at DEKRA IOL, highlights the importance of this accreditation: “This is not just a recognition of our team’s efforts over the past two years, for which I am immensely grateful. It also demonstrates the importance of proactively embracing the new over the old: that is, the many regulatory and accreditation changes that have characterised the training environment recently. It is furthermore a strong capability and reputational endorsement, and an indication to our clients that their confidence and faith in us is justified.”

In addition, this QCTO accreditation reaffirms the IOL’s commitment to making

a tangible difference by growing people through skills and occupational training and development, enhancing their employability and reducing South Africa’s high unemployment rate.

“Driven by the modern mandatory requirement for trained First Aid responders – regardless of company size – across all industry sectors, First Aid training is crucial for workplace safety. It is, however, not medical treatment and cannot be compared with what a trained medical professional provides,” Mörsner emphasises.

DEKRA IOL’s proactive approach in obtaining the QCTO First Aid course accreditation positions the company well ahead of its industry competitors, providing IOL’s clients with a clear strategic advantage in delivering fully accredited First Aid training that meets regulatory requirements.

The IOL was also part of the technical committee which contributed to shaping the new QCTO-accredited First Aid cur-

riculum – along with emergency response and other healthcare professionals and subject matter experts.

“Furthermore, by facilitating workshops and providing clarity for the South African adult-based education

industry on the transition from legacy unit standards to QCTO standards, we have empowered industry to navigate these changes effectively – reinforcing our dedication to fostering a culture of safety and skills development, in line with the ethos of our 99 year-old parent company Dekra. We remain steadfast in our mission to empower individuals and organisations with the knowledge and skills needed to thrive in today’s dynamic and demanding work environment,” says Mörsner.

<https://dekraiol.co.za>



Christopher Mörsner, Head of Training and Consulting at DEKRA IOL.

Hot dip galvanizing and the circular economy

Referring to an article entitled ‘A bright future for hot dip galvanized steel in the circular economy’ by Bruno Dursin, Robin Clarke, executive director of the Hot Dip Galvanizers Association of South Africa (HDGASA), says it is time to move away from linear business models where products are manufactured from raw materials and discarded at the end of their perceived usefulness.

Dursin points out that the steel industry is already contributing to a circular economy. It is actively promoting and developing the use of high-strength and advanced high-strength steel grades, which means less steel is needed to achieve the same functionality.

Hot dip galvanising further contributes to this by extending the service life of steel, says Clarke. “Hot dip galvanizing controls the corrosion of carbon steel in two ways: it forms a barrier against the environment and – should this barrier be compromised – the remaining zinc forms an anode and provides cathodic protection to the steel substrate,” he explains.

The thicker the galvanized coating, the greater the level of corrosion control and the longer the service life, he says. “When increasing the service life of carbon steel, two elements must be considered: the environment – the quality of the air, soil or water – and the thickness of the coating. In

a relatively gentle or benign environment with modest levels of pollution and rainfall, a galvanized coating can provide a service life of over 80 years. In more aggressive environments, we need to look to guidelines from ISO 9225/3 and ISO 9224 to predict the service life – which can be between 15 and 25 years.”

In highly aggressive (corrosive) environments, the HDGASA recommends the use of duplex coating, a galvanized coating that is supplemented with a paint system to extend service life.

Ideally, Clarke adds, buildings should be specifically designed for reuse, to the point where the same building can even be relocated. “When we demolish a traditional building, we end up with a lot of rubble that cannot be repurposed. If we had a building largely constructed from steel, we could reconfigure it differently, or design a building using elements that can be reused with minimal rework,” he suggests.

A great example is The Green House in Utrecht in The Netherlands, which was built as a temporary structure on land identified for reuse. The Green House is a ‘circular’ hotel/catering concept with conference facilities. This two-layer pavilion was designed as a generic steel frame construction comprised of hot dip

galvanized profiles, that can be disassembled and rebuilt at another site.

Clarke supports Dursin’s point that zinc, which is integral to the hot dip galvanizing process, can be recycled over and over without any loss in quality. However, there are challenges in South Africa. Here, zinc ash and zinc dross, which are by-products of the hot dip galvanizing process, are regarded as hazardous waste, despite the fact that they can be recycled back to pure zinc or into oxides that can be used to make tyres, fertilizer and medical products.

“South Africa’s hot dip galvanizing sector, like its global counterparts, is now more efficient in capturing and controlling emissions and ensuring that all chemicals, chemical elements and molten metals are managed in accordance with best practice,” Clarke concludes.

www.hdgasa.org.za



The Green House in Utrecht, The Netherlands, built as a temporary structure on land identified for reuse.

Phased array UT, UT-TOFD and the VEO³

The advanced Sonatest VEO³ phased-array and time-of-flight diffraction (PAUT and TOFD) ultrasonic testing instrument, available in South Africa from GammaTec, offers simplicity and detection reliability for all critical applications, most notably, NDT on nuclear infrastructure.

GammaTec has been a key provider of NDT equipment to South African industry since 1981. Since establishing a relationship with Necsa's NTP Group of Companies in 2009 for the global distribution of locally manufactured radioisotopes, however, the company has grown into a global NDT equipment provider.

GammaTec's head office remains in Vereeniging, South Africa, where it directly services its customers as well as its extensive distribution network, which covers Africa, the Middle East, Asia and Europe. "We are now able to provide a high profile 'ground floor' NDT presence across the world, with exports to over 70 countries worldwide," Ralph Davies, the company's MD tells *African Fusion*.

The International Atomic Energy Association (IAEA) promotes the use of NDT technology to maintain the stringent quality control standards for the safe operation of nuclear and other industrial installations. To meet the expected nuclear needs of Africa, the IAEA is currently funding an NDT centre of excellence for the nuclear industry at NECSA's Pelindaba nuclear research facility, with the SAIW leading the project. This project, which is specifically aimed at encouraging women into the profession, will focus on two advanced high-end NDT methods, phased-array ultrasonics (PAUT) and Ultrasonic Time of Flight Diffraction (UT-TOFD).

Sonatest's VEO³ PAUT and TOFD testing instrument

The new Sonatest VEO³ ultrasonic instrument that Gammatec distributes and supports allows inspectors to keep inspecting as they always have, with no need to change their current workflow. A key benefit of using advanced phased array UT

instruments such as the VEO³ is Total Focusing Method (TFM) technology, which, because of the vast amounts of data collected using the ultrasonic array probes, enables the user to synthetically focus in on every point of a region of interest.

This delivers excel-



Sonatest's VEO³, available in South Africa from GammaTec, can be used for phased array UT (PAUT) and Time of flight UT (UT-TOFD) using the live Total Focusing Method (TFM).

lent resolution and sizing performance, with the additional benefit of using an already approved, trusted and reliable UT procedure.

Unique to the VEO³ is the advanced Total Focusing Method Intermodal (TFMi™) mode, which Sonatest introduced with the VEO³. TFMi allows up to four propagation modes to be combined into a single acquisition window and provides a high-fidelity image of defects to aid in characterisation and sizing.

Specific features of the VEO³ also include:

- **Superior digital technology:** The VEO³ can deliver fast and accurate results using an impressive 32 channel phased-array beamformer that provides an exceptional signal to noise ratio due to enhanced digital signal processing. Thanks to its 64-bit Linux operating system and a fast 128 GB SSD memory capacity, huge amounts of information can be recorded for analysis in a single acquisition file.
- **Multi-scan/multi-technique capabilities:** With its advanced technology, the VEO³ is unique in allowing real-time multi-scan/multi-technique capabilities, making simultaneous TFM, TFMi, PA and TOFD views possible.
- **Intuitive menus and workflow:** Inte-

grated help and wizards guide the user through scan set up whilst optimisation tips ensure the VEO³ always performs at the highest level. Fast and efficient setup wizards for sound velocity; wedge delay; time, distance and amplitude correction; and encoder calibration are all provided as standard.

An inspection plan shows the operator in 3D where probes are positioned on the test part, simplifying the inspection set up and providing an inspection reference for reporting.

Using the latest computer technology, data can be permanently recorded for processing and report generation.

The VEO³ can freely run up to eight groups combining PA, TFM and TFMi groups in the same scan: with any combination of up to six TFM, one TFMi™ and eight PA groups. This creates a rich insightful layout of S-scan side views and the latest TFM imaging at the same time. Having both PA and TFM in the same scans saves time, where other systems may need to do these scans separately.

All the data received during scanning can be recorded on the instrument, enabling further detailed analysis to be performed later – whether on the instrument or on the inclusive UTStudio+ PC-based software application. Comparison with previous inspection data to identify trends and flaw/corrosion growth rates are also possible.

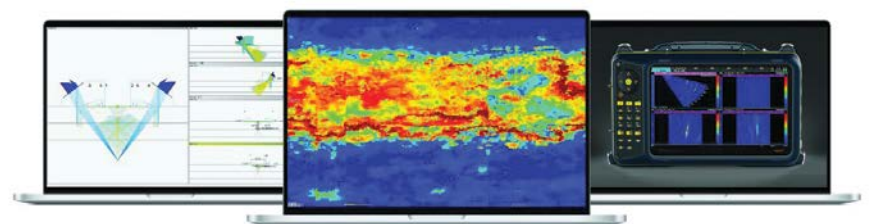
"The ability to reliably find and accurately characterise different types of defects is now really easy, making these advanced techniques more powerful than ever in the hands of competent NDT professionals," says GammaTec's Ralph Davies.

"The VEO³ is ideal for meeting the rigorous NDT requirements of the nuclear industry," he concludes.

www.gammatecsa.com



This QR Code links to a video of a VEO³ phased array scan of a centreline crack on a double V butt weld.



The VEO³ features real-time multi-scan/multi-technique capabilities, making simultaneous TFM, PA and TOFD views possible.

WARRIOR EDGE 500 DX



PRECIDRIVE

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PROTECTS YOUR WELD



Warrior Edge 500 DX is an easy-to-use, high-performing and connected multi-process welding machine featuring the WeldModesPulse, SPEED, THIN and ROOT.

- High performance WeldModeTHIN reduces spatter levels and helps reduce distortion when welding thin plates
- With a gap bridging ability, the easy to control ROOTWeldMode is optimized for root passes
- Adaptive optimized Pulse MIG process that compensates for operator variation with an easy, user-friendly setup designed to achieve excellent weld results
- Fit for purpose WeldModeSPEED provide a focused arc that allows the welder to better and easier handle the weld pool at higher travel speeds increasing the productivity
- Integrated 1.4 kW high performance cooling unit
- Integrated WeldCloud connectivity

RobustFeedEdge features

- TrueFlow, the digital gas flow control system from ESAB, effectively manages shielding gas both in starts and while welding thus improving quality and decreasing consumption
- Effective and quick to set-up operator management system with key card that allows locking down quick-jobs with setting limits improves repeatability and adherence to welding procedure specifications
- The 2021 Red Dot design award winning design provides well-designed ergonomics and intuitive user interface that reduces training needs for operators
- SpoolSafe-unique in the market IP54 protection against dirt/dust, keeping your wire dry and clean, protecting the integrity of your weld
- A hybrid HMI solution with material selection and configurations on a TFT-screen inside the unit with a clear and easy to use external display for everyday operation makes unit easy to operate
- Integrates with the Exeor DX torch models graphic display remote without the need for additional connectors

Visit esab.com for more information.



Exeor MIG 4.0G², 4.0G² CX and 4.0G² DX Torches

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Consistent quality
Reliable delivery

BHI

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**Bell Heavy Industries is a
new division of Bell Equipment
focused on project engineering and
contract manufacturing.**

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