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This article by Jürgen Tuchtfeld, Thomas Assiom and Issam Chiguer of voestalpine Böhler Welding, UTP Maintenance, describes welding applications for the cement industry, where hardfacing applications of highly stressed components as well as repair welding of broken parts are part of the daily routine.

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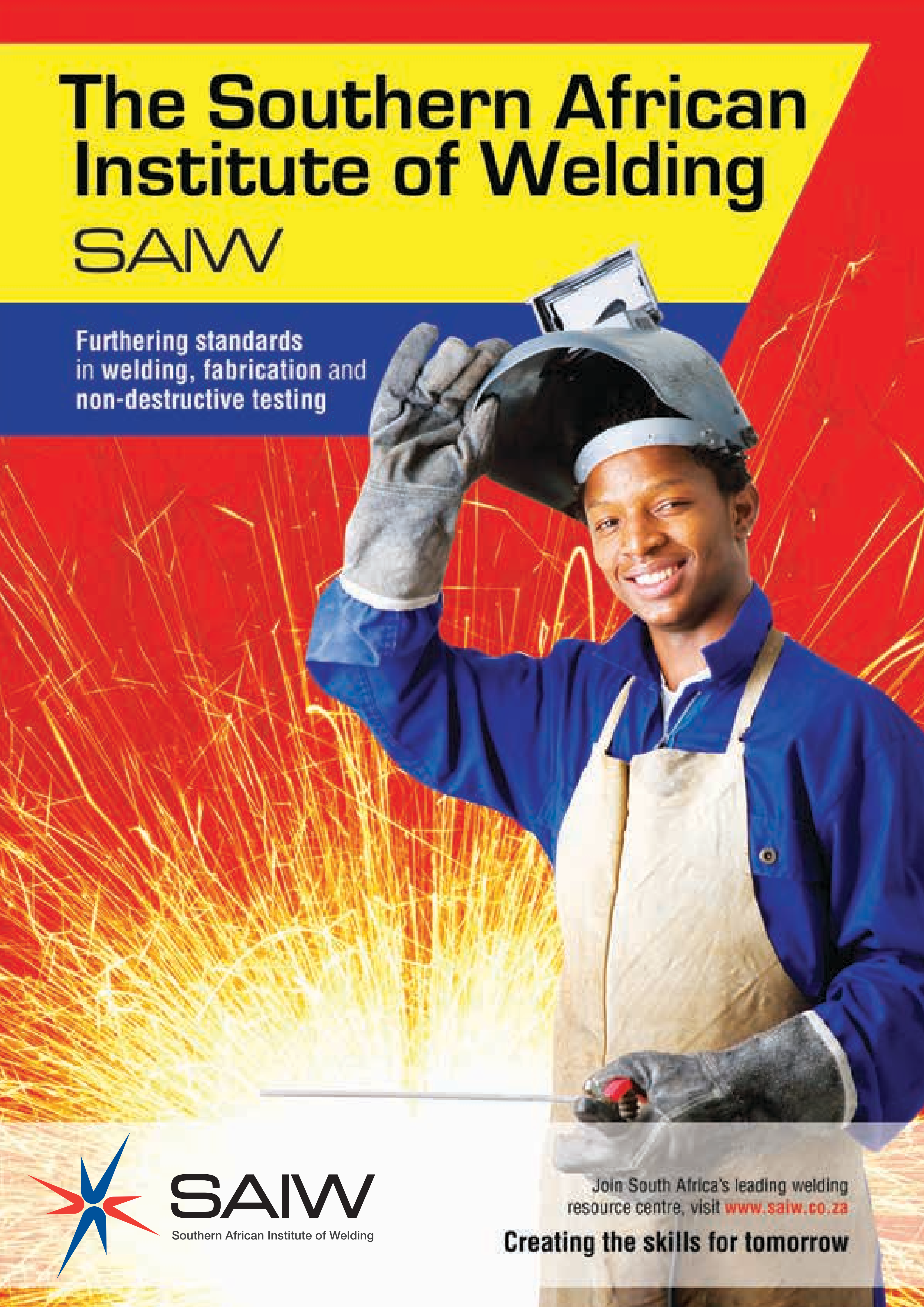
The Southern African Institute of Welding
SAIW
Furthering standards in welding, fabrication and non-destructive testing
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Now that the municipal elections are behind us, we can all look forward and renew our collective efforts to better support industry and small businesses. Most importantly, we hope that industry projects will be released that might help our economy to recover. South Africa is in need of new base-load power plants – coal, nuclear or both – to increase capacity and replace aging and inefficient plants. We hope that government sees the need to move urgently towards creating clarity on the direction we are going to be taking to meet these needs.

If we are going down the nuclear route, it will change the face of industry, with many people requiring training to nuclear standards and protocols. We see a long path to upskilling our people to this level, but South African's have always managed to make the most of challenges in the past. These things cannot be rushed, though, and the sooner we start the better.

Industry is the backbone of our economy and SAIW, along with our sister institutes and organisations, sees its role as supporting and advancing the interests of industry. Much work is being done to promote fair competition and the introduction of tariffs to protect local industry, most notably the local steel manufacturing industry. We are currently engaged in an initiative around mandatory standards and are working with a broad spectrum of stakeholders on the required standards for welding consumables. We all agree on the need to ensure that products entering the country are on a par with respect to quality and safety to those locally manufactured. Such regulations are necessary to ensure that competition is fair and that our own fabricators are not being disadvantaged by poor quality and/or heavily subsidised imports.

The railway rejuvenation programme remains encouraging and the second visit by our Duisburg-based partners, GSI-SLV, to certify South African railway component fabricators to EN 15085 is imminent. Transnet Engineering's Durban facility has already been certified to EN 15085-2 level CL1 and we look forward to the Koedoespoort facilities also being certified following the upcoming audit. A number of other component manufacturers are also being visited during this visit.

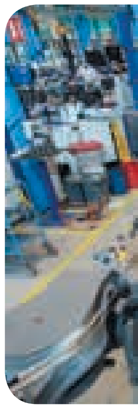
During a recent trip to Europe I visited the Alstom bogey manufacturing facility that was busy building the initial bogeys for the PRASA project. It is a world-class facility with all the necessary process and certifications in place. What they do was eye opening, but I am sure that South African manufacturers can emulate these standards. Manufacturers that wish to benefit from the Transnet and PRASA locomotive and passenger train-building programmes need to adopt EN 15085 railway welding standards in order to participate. We look forward to hearing from interested companies.

Congratulations are again due to Jaco van Deventer, SAIW's Young Welder of the Year, who performed excellently in the Chinese Welding Society's Arc Cup. SAIW is working closely with WorldSkills and other organisations to promote the development of our youth and improve the quality of welding education in our colleges to support the development of our industry. We are pleased that a world-class welding curriculum is being adopted as the national standard for training welding personnel. These initiatives will raise standards and the status of welding as a career – and Jaco is a great role model in this regard.

Our annual opportunity to network and celebrate success, the SAIW Annual Dinner and Awards is taking place on September 23. I hope to see you all there.

Sean Blake

Nuclear and railway fabrication: the



SAIW executive director *Sean Blake* shares experiences of his visit to France, where he toured the Chalon Saint-Marcel manufacturing plant of Areva Heavy Equipment before visiting Alstom Transport in Le Creusot.

Following a visit by a French delegation to the SAIW facility in February 2016, an invitation was extended by Areva to visit its Heavy Equipment Manufacturing facility in St Marcel – Chalon, France. This facility was opened in 1976 and some of the components for the Koeberg Nuclear Power station were built in that facility. The facility primarily manufactures the steam generators for Areva's 3rd generation EPR nuclear power plant.

Some of the components for the Koeberg steam generator replacement project may also be manufactured in the facility with the balance planned for manufacture in an Areva manufacturing facility in China. I took the opportunity to visit this facility in conjunction with IIW meetings scheduled for May 25 and 26 in Gent, Belgium for the IIW Inspector working group.

During discussions with Areva personnel, they suggested that I could also visit the Alstom Transport site in Le Creusot, which is a short drive away from Chalon. The Alstom Transport facility is in the process of building bogies for PRASA and is the technology partner for Gibela, which is currently establishing a manufacturing facility in Dunnotar, Nigel for the local manufacture of passenger rail vehicles.

AREVA Heavy Equipment

The fabrication facility is composed of four bays, an ancillary bay for support activities including welder training, a light bay with capacity for up to 50 t, a medium bay for up to 350 tons; and a heavy bay for fabrications of up to 1 000 tons. The facility employs 364 operators of which 62 are boilermakers, 80 are welders, with 348 technicians and 205 managers and engineers. Due to the nature and quality requirements of the products manufactured at this facility, there is a high ratio of engineers and technicians to operators. Quality control and engineering are key factors in this operation with a ratio of one manufacturing hour for each engineering hour.

Manufacturing methods have been studied and developed specifically for the Areva activities and have been developed over a period if more than 30 years. The drilling and broaching process is a key example of this, where tubes sheets of up to 600 mm thick are drilled and broached to an accuracy of 0.01 mm. A matching sample is kept of every tube sheet bored as a quality control requirement.

Owing to Koeberg being built by Framatome (a predecessor of Areva), a close working relationship is maintained between Eskom and the French power consortium of Areva and EDF.

All assembly operations are conducted in clean rooms. Unfortunately, due to the cleanliness requirements and rules of the facility, I was not able to enter the assembly area, however, I could view the operation from the outside through a glass window. The assembly is carefully controlled with each item being identified and weighed with multiple checks to ensure proper assembly.

Within the facility, there is a welding technology department, which is working on a number of new welding developments, including developing welding processes for the ITER Tokamak nuclear fusion project. They are also working on powder metallurgy solutions using Hot Isostatic Pressing (HIP) technologies as well as the joining of a stainless steel/copper and beryllium composite for water cooling for this project. The development group is also working on GMAW welding techniques as well as the automatic feed of filler material for GTAW welding in order to improve productivity and automation.

Within the facility they have a welder training and testing facility, which is manned with training instructors and welding management. For a welder to work on the nuclear components, a minimum of 10 years training and experience is required.

Interestingly, Areva is using electroslag welding as a weld build-up and cladding technique. The process is preferred for some applications due to the low dilution achieved. Within the facility they are also using robotic GMAW welding as a cladding process. Polysoude's TIGer (TIG with and electric resistance/hot wire feed) is utilised in order to improve productivity.

The facility has a second welder training facility that is remote from the manufacturing facility. Within this facility there are two welding bays with simulated environments where welders are trained and tested in a temperature and humidity controlled working environment with jigs for restricted access. Much of this second welder training facility was dedicated to the use of automated welding techniques with training and development of narrow-gap orbital

French way

Left: The Chalon Saint-Marcel manufacturing plant of Areva Heavy Equipment in France. The facility is composed of four bays: a support bay; and light, medium and heavy bays for sub-assemblies, assemblies and components of 50 t, 350 t, and up to 1 000 t, respectively. Centre: For in-service inspection of reactor pressure vessel, NETEC has developed the MIS manipulator for remote and automatic NDT inspection. Right: A view of the bogie assembly line at Alstom Transport's EN 15085 CL1-certified Le Creusot site in France. Photo courtesy of Alstom Transport.

TIG. All the welding equipment was supplied by Liburdi.

AREVA –NETEC

I also visited Areva's non-destructive examination technical centre (NETEC) during my visit, which provides NDT services to industry, Eskom being a notable customer. The centre employs 330 people with 85 personnel in research and development, along with 155 NDT agents all certified by COFREND, the French NDT personnel certification body.

NETEC has developed the MIS manipulator, which is inserted into the reactor pressure vessel with a number of inspection tools for automated in-service inspection of the vessel. Inspections are undertaken in accordance to the requirements of RSE-M and ASME codes, which define the necessary in-service inspection operations.

The developments that NETEC are working on are the replacement of RT with UT and the replacement of PT with PTC (photo thermal camera) testing. This technology may replace MT, PT and even ECT (eddy current testing) in some cases. The organisation is continually working on different probe designs in order to meet specific in-service conditions. An example of probe designs being worked on is new single or arrayed eddy current probes, eddy-current probes for inspection of heat exchanger tube bundles being one of the key competencies of the organisation.

An exciting development that NETEC is currently working on is thermography and they see many opportunities for this technology. The technology can be used to accurately locate indications by using thermal imaging using a camera 10 cm to 2.0 m away from the component being examined – and the component can be at temperatures of up to 300°C.

The technique enables inspections to be done more quickly, since the component does not need to be cooled down to room temperature for inspection as is required for conventional inspection techniques. Complex shapes can be inspected with better resolution than conventional techniques. Thermography can also be used as an alternative to MT testing, as has been demonstrated by the successful use of this technology for the inspection HVOF coated Pelton wheels. Thermography technology relies on a laser heating the surface of the component under investigation. Any cracks will prevent heat conduction, allowing the crack to be detected by the thermal camera. Examples seen show that the resolution was far superior to that obtained via penetrant testing (PT), which was traditionally used.

Alstom Transport – Le Creusot

The director of the International Institute of Nuclear Energy, Yves Fanjas, and I visited the Alstom Transport manufacturing facility together. We were hosted by Sebastion Ciron and Francoiss Vachon who are the responsible welding co-ordinators for the manufacturing facility.

The facility has been certified compliant to EN 15085 by GSI-SLV who is the leading organisation for certification to this railway manufacturing standard. The facility employs 670 permanent employees, 38% are operators and 32% engineers – once again a high ratio of operators to engineers. Currently, the organisation has approximately 100 projects in development and an order book spanning three years of activity. 1 500 railway bogies are manufactured each year as well as 15 000 dampers, which are the facility's primary products. The facility is also the design authority for all projects.

Alstom Transport is working closely with Gibela on the PRASA project and while I was visiting, one line was dedicated to manufacturing the initial bogies for the PRASA project. The primary competencies of the facility are welding and machining.

Bogies are fabricated at this facility from 6.0 to 25 mm boilerplate (Grade P355 NL and P275 NL). Welding operations are extensively conducted by robots due to the lack of welding skills in most areas as well as to improve working conditions in the workshop. Wheels and axles are purchased from external forging facilities located in France, Italy and China and gearboxes, brakes and suspension components are also sourced from third party suppliers.

Incoming plate material is prepared by shot peening before being cut using plasma machines. The weld preparation follows, the plate is champhered with no cutting lubricant being used, due to possible contamination leading to welding problems. The facility applies a flatness specification of 1.0 mm/m to its plate material.

All components are assembled in jigs and all jigs are manipulated such that welding can be done in the flat position. There is a strong focus on fatigue improvement techniques throughout the operation. Root runs are done manually as a human welder can perform a better quality weld than a robot, taking into account variations of fit-up. All butt welds have run-on and run-off tabs, which are removed from the final assembly. All start-stops are ground to remove any defects in this portion of the weld and TIG dressing is performed extensively as a fatigue improvement technique on the assembly.

After fabrication, the bogie is stress relieved in a heat treatment furnace. Welds around corners are also done manually as it has also been found that quality is better where there are possible dimensional variations, which cause problems for robots even when seam tracking technologies are used.

Quality control is a key feature of the operation with all components being identified. There is complete traceability of the manufacturing process, with each operation recorded including welder identification, which is also stamped onto the frame.

All structural welds are inspected using ultrasonics (UT) and Alstom is working on utilising phased array technologies, however, this is limited due to the lack of standards in this area.

SPE takes on railway fabrication opportunities

***African Fusion* visits the Roodepoort facilities of Stainless Precision Engineering (SPE) and talks to Reginald Diedericks (left), the responsible welding coordinator and technical quality manager, about the company's ISO 3834 quality accreditation and its EN/ISO 15085 and railway aspirations.**

Stainless Precision Engineering (SPE) is a privately owned company founded in 1989 as a jobbing shop that relies on state-of-the-art machinery to produce high quality sheet metal products and components. "We operate a cluster-style management system, with the factory headed by production controllers, overseen by our production director and quality manager," begins Diedericks. "The secret of our success is that each cluster is accountable for the goods it produces and their quality," he adds.

"From a quality and inspection perspective, we believe it is important to control quality at source. Before beginning a run on the laser cutter, for example, the operator first completes a test plate cut. He is then responsible for measuring, checking and signing off the test part, based on very specific criteria presented to him on the machines SCADA. Only once the operator has completed the on-screen sign-off process, will the machine allow the remaining identical parts to be produced," he explains.

SPE's 6 500 m^2 factory floor is dominated by Amada CNC machines. For laser cutting, the company has four FO-3 015 4.0 kW lasers with 3×1.5 m cutting beds capable of cutting thicknesses of up to 20 mm in mild steel, 12 mm in stainless steel and 10 mm in aluminium. In addition, the company has an RI (rotary index) version of the Amada FO-3 015 laser that can also cut or profile 6.0 m lengths of round pipe up to 220 mm in diameter; square tube from 19 to 150 mm; angle sections of 90×90 mm; and 150 mm channel sections.

"Laser cutting machines, coupled with the CNC process, enable us to rapidly produce complex and highly accurate flat profiled parts that are easily replicated," Diedericks points out.

Every weld has a welding procedure qualification developed according to ISO 9606-1. Welders are qualified to ISO 15614-1 for carbon and stainless steel and 15614-2 for aluminium, depending on the welds allocated to them.

SPE's modular punching machines offer flexible manufacturing runs without the need for expensive dies and stamping presses – and high volumes are not required to justify the use of this equipment. A 55 station Vipros 255 20-ton Turret punch is available, as well as two 30-ton 49-station Turret punch presses, one of which is coupled to a 4.0 kW laser combination.

SPE offers substantial tooling capabilities for bending stainless steel, mild steel and aluminium in almost every combination. The most impressive of the bending brakes is an AMADA Astro robotic bending system with a 130 t capacity along a 3 000 mm length. The system's robot picks up a part, measures it and then transfers it to a manipulator on the bending brake itself. The part can then be repositioned as many time as necessary to compete the bending processes, before being transferred out of the cell. Another eight CNC press brakes are in use with up to 7-Axis control, 35 to 200 t capacities and 4 280 mm lengths.

Welding and fabrication

Diedericks, the responsible welding coordinator for SPE's jobbing shop in Roodepoort, Gauteng, is an artisan boilermaker with a Red Seal certificate and an SAIW Level 1 Inspection qualification. Along with deputy welding coordinator, Gavin Armstrong and a dedicated welding inspector, his team manages the day-to-day quality on the assembly side of SPE's offering.

"Our welders do their own assembly, which is not quite as complex as boilermaking and we now have 30 full-time welders who have all been trained in-house and qualified for the welding procedures we use. Every weld has a welding procedure qualification developed according to ISO 9606-1. We then allocate welders to assembly work and qualify each one for the welds involved – to ISO 15614-1 for carbon and stainless steel and 15614-2 for aluminium," Diedericks tells *African Fusion*.

"I have personally employed 17 new welders over the past 18 months to cater for the growth in the business. We look for people who have a practical welding background and we initially test them to see if they have the hand for welding. Then we train and qualify them according to the actual welding work they will be performing," he says, adding: "We apply the same approach to the grinding and polishing teams, establishing

SPE's AMADA Astro robotic bending system has a 130 t capacity along a 3 000 mm length. The system's robot picks up a part, measures it and then transfers it to a manipulator on the bending brake, where the part can be repositioned as many time as necessary to compete the bending processes.

To support the higher volume parking systems' work, welding assembly is supported by three Fanuc/Lincoln electric robotic welding systems: a two-robot cell that includes a 4.0 t manipulator and two multi-axes turntables and a second robot for sub-component assembly.

procedures and then training them to do what needs to be done."

In keeping with its belief in state-of-the-art machine tools, welding assembly is supported by three Fanuc robotic welding systems. The largest is a two-robot cell that includes a 4.0 t manipulator and two multi-axes turntables. A second Fanuc robot is employed as a sub-component assembly station. Both systems use Lincoln welding equipment and are supported by Pretoria-based Robotic Innovations.

"The robot system is used extensively for our ongoing parking systems' work. The two-robot cell welds the fingers that rise up from the ground at the boom gates to prevent non-payment. The turntable allows the whole part to be rotated for better access to all of the welding required. Boom gates and parking system consoles have long been our flagship capability and we manufacture these for a number of different OEMs," says Diedericks.

"On the manual side, we use mostly the MIG/MAG welding process with some TIG welding. We also have five spot welding machines and a stud gun," he adds.

Returning to welding quality management issues, Diedericks says the quality at source approach runs through every aspect of component manufacture. "On the welding side, we do a before, during and after inspection, with our welding inspector taking primary responsibility. Then, after grinding, we apply a visual inspection and sign-off stage to 100% of the assemblies.

Since very early in its inception, SPE has been ISO 9001-certified, but since Diedericks' arrival, ISO 3834 certification has been implemented to further enhance the quality and creditability of the company on the welding side.

"Our ISO 3834 welding quality system was built from the ground up, with procedure development and training at the root of implementation. It was a mindset change for the fabrication team on the shop floor, to first look for the procedures that applied to the job and then to routinely apply them. On the other hand, welders had to get used to not doing any work that they were not yet qualified for.

"Our welders were willing to learn, though, and they applied the new system with enthusiasm. The whole team has gone out of its way to make ISO 3834 work for us, to improve weld quality and production performance," Diedericks notes.

"Quality gives us a competitive advantage: We now offer excellent quality on the welding side and this is appreciated by management and customers, resulting in new contracts and in significant growth. So much so that we are having to extend the workshop space to accommodate the additional work," he adds.

Due to the significant increase in railway contracts being awarded to SPE, the company is also gearing up for ISO 15085-accreditation for the manufacture of railway components and structures. "We are currently involved with Bombardier, fabricating high voltage cubicles and traction converter cabinets for one of the South African railway rejuvenation projects. We are also making the frames for 2.0 m locomotive radiators for a railway sub-contractor and, in aluminium, we have started to fabricate the driver control panels for railway climate control solutions," Diedericks reveals.

SPE is currently fabricating high voltage cubicles and traction converter cabinets for South Africa's railway rejuvenation projects.

"We are aiming to become a railway specialist, hence the need for ISO 15085. We expect to be audited during August and we hope to be CL2-accredited before the end of this year," he tells *African Fusion*.

"SPE is constantly striving for product excellence by keeping up-to-date with the latest technologies and trends in the sheet metal Industry. We guarantee excellent service to all our clients with timeously delivered, quality-inspected goods that are certified to international quality standards," he concludes.

Supporting good welding practice

SAIW's July graduation dinner for 2016 was celebrated at Emperors Palace on Friday July 22. Presenting the motivational address, Gert Joubert of ArcelorMittal unravelled the different roles of those involved in welding projects for the benefit of graduates' family, spouses and partners.

"We talk a lot about the integrity of a weld, but what is that and how does it relate to inspection?" he asks, before identifying three cornerstones for successful welding.

"First you need good metallurgy, from good metallurgists such as our own Professor Koursaris, who understands what happens inside a steel. Having completed an SAIW inspection course, your loved-ones' heads are full of what happens inside a heat-affected zone; of material microstructures – martensite, pearlite and austenite – and of treatment processes such as pre- and post-weld heat treatment. Inspectors have to studied all of these things and yours have passed exams about them," he says.

Second is the design. "A design engineer has in his head knowledge of welding codes, specifications, calculations; yield and tensile strengths of materials, Charpy toughness values; and ductile to brittle transition temperatures. Does this sound familiar? These are also things that inspectors learn about, because they need to ensure that designers' intentions are being applied correctly," Joubert explains.

Third, he notes, is the welding process side, with welding engineers and technologists specifying exactly how a weld needs to be completed. "So we need to know about welding processes: MIG welding, pulsed arc, spray transfer, globular transfer, arc plasmas – all of the science that is behind producing a good weld."

Joubert uses the triangle formed by a three-legged stool to describe good welded construction: "In one corner is the design engineer. But even if that corner is well established, the stool can topple over in any direction. At the second corner is the metallurgy and all of the knowledge about the metal needed in a sound weld. But even with both of these corners in place, the stool will still roll over along the line between these two points.

"So you need a third point of balance. The welding processes, the inspection integrity, the welder skills and the quality controls. Unless all three corners of this stool are properly established and in place, good welding will not be supported and the structure being welded is heading for collapse," he warns.

"You can't inspect quality into a bad product. You can't take a good welding machine and lay down a good weld without any skill. You can't overlook the loading conditions that a structure has to deal with in practice. Every conceivable possibility needs to be in well thought through and brought into balance," he adds.

"Inside and throughout the base of this triangle, all stakeholders need to have knowledge and skill. The knowledge that you are bringing into the industry as inspectors is of utmost importance to keep this stool stable and balanced," Joubert tells graduates, adding "treasure your knowledge and look after it. Keep it in the right place and use it well."

Following Joubert's talk, two candidates received International Welding Technologist (IWT) diplomas; four became International Welding Specialists and 15 students were awarded Inspector Level 2 certificates along with the IIW Standard Welding Inspector qualification. A further 13 graduates received SAIW Level 2 Welding Inspector certificates while 51 more graduated as SAIW Level 1 Inspectors, four of them with distinction.

Two of South Africa's most recent International Welding Technologists (IWTs) receive qualification certificates from SAIW president, Morris Maroga. Top: Melba Mothapo. Above: Phumudzo Mudau.

The SAIW Annual Dinner and Awards

SAIW's 68th Annual Dinner and Awards ceremony will take place on Friday September 23 at the Gold Reef City Conference Centre.

To be MCd by South African radio DJ, singer, actor voice artist, television presenter and traffic reporter, Bongani Nxumalo, with additional entertainment from Coda Africa – an exciting merge of an electric violin and cello with a house DJ, an African vocalist and a rock saxophone – the event is sure to be a night to remember.

To book, download the booking form from the SAIW website or contact Rencia Grundlingh.

rencia.grundlingh@saiw.co.za

SAIW courses and events

Heat Treatment for Engineers, Andy Koursaris
12-16 Sept, SAIW City West, Johannesburg
Shelton Zichawo
+27 11 298 2148
shelton.zichawo@saiw.co.za

Welding Coordination: ISO 3834 and ISO 14731
28 Sept, Secunda; 19 Oct, Johannesburg; 16 Nov, Cape Town; and 23 Nov Durban.
SAIW: Laetitia Dormehl
+27 86 648 8165
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Appreciation of welding, Nico Fourie
3-7 Oct, SAIW City West, Johannesburg
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Advancing NDT as a profession in South Africa

At the launch of South African Institute for Non-destructive Testing's (SAINT) bi-annual Yearbook, *African Fusion* talks to current president, Keith Cain about advancing the creditability and professionalism of NDT in South Africa.

SAINT president, Keith Cain presents at the launch of the NDT Institute's bi-annual Yearbook: 'Cornerstones of NDT, 2016/2017'.

"This is actually our second book and it is bigger and more formal. We wanted a combination of an interesting coffee table book and a reference book for NDT professionals that can support their day to day needs – and the 2016/2017 book is full of explanations of the different methods and examples of best practices and procedures," begins Cain.

"Our vision is to be the cornerstone of South African NDT, which is also the title of the 2016/2017 yearbook. As well as supporting NDT technicians and professionals, we strive to raise awareness of the NDT field as a specific and important branch of engineering. NDT professionals are responsible for testing the true condition of critical structures, components or vessels used on industrial plants. Based on the results of NDT inspections, engineers often have to sign-off on the fitness-for-purpose of plant equipment so that it can continue to be operated safely.

"Yet in spite of the vital nature of this role, NDT it is not well known or respected as a discipline in its own right, which is somewhat frustrating. So we continue to raise awareness of the field, its importance and its credibility," he tells *African Fusion*.

"NDT is even being performed on Mars. When the Mars Rover takes a rock sample from the planet, it uses NDT-type testing techniques to test and analyse the rock sample before sending the results to Earth. Similar NDT principles, methods and techniques are being applied to plant equipment every day," Cain argues.

Welding, according to Cain, is highly dependent on NDT. "Welding is like casting, a molten strip of metal fuses to solid metal on either side of the joint. This results in significant changes to the properties of the materials at the joint and if these changes are not managed correctly, they can seriously impair the integrity of the whole structure. Also, defects such as lack of fusion or porosity can be introduced during welding, or the weld may crack after welding due to shrinkage or a combination of cooling stresses and hydrogen, for example. These flaws are usually impossible to see with the naked eye. NDT has a critical role to play in both finding such flaws so that they can be repaired and validating the integrity of a completed weld so that we know that it can be safely put into service," he explains.

"But the need for NDT is not limited to welding. There are more than 100 different testing techniques that are applied in all sorts of fields, leak and pressure testing, for example," he adds.

The 'big five' NDT techniques in common use are penetrant testing (PT); magnetic testing (MT); ultrasonic testing

SAIW executive director, Sean Blake, receives his copy of the SAINT yearbook from Keith Cain. From left: SAIW's Harold Jansen; Keith Cain; Sean Blake; with the books publisher from CVR Publishers and Design, Bev Lawrence and Jeannie Campbell.

(UT); radiographic testing (RT); and the fifth, eddy-current testing. "Eddy current testing is widely used on aircraft, for example, to make sure they are safe to continue flying," Cain says. Many of these also have modern derivatives, though, such as phased array UT and digital radiography.

The professional body for NDT

Off the back of the very successful WCNDT conference held in Durban in 2012, SAINT began to transform to better meet the needs of its membership, NDT professionals and NDT users in industry. "To raise the status and professionalism of the practitioners, a professional body was needed to support development and improve the overall status and credibility of practitioners and the profession," Cain says.

Following extensive consultations with stakeholders, the SAINT Professional Body for NDT (SPB NDT) was formed in accordance with the NQF act. "We have also been collaborating with SAQA and MERSETA to establish professional designations within the Organising Framework for Occupations for Level 1 and Level 2 NDT practitioners. These are now referred to as NDT operators and NDT technicians, respectively," he says, adding that the framework for the Level 3 designation as NDT technologist has been established and a venture to establish the NDT engineer designation is set for 2017.

"We are not intending to enforce professional registration but we are going to be moving towards a licensing type of system based on the professional designation. End users will then be encouraged to always use licensed professionals to perform NDT according to their designation," Cain explains.

SAINT is also now pursuing registration with the Quality Council for Trades and Occupations (QCTO). "NDT is not yet a trade and we want it to be. We want young people to be able to do an apprenticeship and get a formal NDT qualification. Then NDT can become a formal occupation with SAINT as its professional body, hosting and accrediting evenings and courses to allow practitioners to accumulate CPD (continuous professional development) points to maintain their professional status," he says.

SAINT has chosen to adopt a hybrid approach to NDT qualifications and professional development, based on the best features of ISO 9712 and ASNT recommended practice. "ISO 9712 is very strong on the training and certification of NDT individuals, while the ASNT approach has a better focus on work place experience and on-the-job training. By merging the two systems, we believe industry and qualified practitioners can benefit from the best of both systems," explains Cain.

"We aim to become a benchmarking Institute in South Africa. Slowly but surely, we are raising interest and improving the credibility and professionalism of NDT industry for the overall benefit of our members, South Africa and industry in general," Cain concludes.

> *"A professional body was needed to support development and improve the overall status and credibility of practitioners and the profession."*

Young SA welder second in China's 'Arc Cup'

Jaco van Deventer, previous winner of the local welding industry's Young Welder of the Year competition, hosted by the Southern African Institute of Welding (SAIW), has been placed second in the Youth Group for the Finished Product Welding category at the Arc Cup hosted by the Chinese Welding Society (CWS) and supported by the International Institute of Welding (IIW).

There were a total of 304 competitors representing 24 countries apart from China. The Chinese contingent included 17 Chinese state-owned large enterprises and 15 Chinese vocational schools.

The Arc Cup, which is regarded as the second most prestigious international welding competition after the international WordSkills event, was originally the Chinese national welding competition for the selection of the Chinese WorldSkills participants. It was then opened to international participation in order to expand the opportunity for welders to get used to WordSkills competition conditions.

"To get second place in this competition is nothing short of amazing," says SAIW's Etienne Nell who was the South African Expert at the competition. "Jaco has proven himself to be one of the best young welders in the world and he deserves every accolade."

Danie Eksteen, technical training manager at Steinmüller, where Van Deventer is employed, says he and the entire company are proud of his achievement. "The circumstances under which Jaco had to work in this competition were, to say the least, extremely difficult. He achieved this outstanding result through discipline, application and hard work. It was indeed a most courageous effort," says Eksteen.

Van Deventer says he is over the moon with the result. "Sometimes the temperature reached nearly 40 °C in the work centre and there was little or no water. It was difficult to concentrate but I knew I just had to persevere," he says.

He added that he must thank Eksteen and Nell for their help and dedication. "Without them I could not have achieved what I did," he says.

Van Deventer entered the GMAW (135) process and selected to weld a pipe in the 6G position as an elective element of the competition.

SAIW promoting welding to youth

Back in South Africa, the well-known Young Welder of the Year competition will now be called the SAIW Youth Welding Challenge. The change is a result of an overhauling by WorldSkills South Africa of its welding competition from which the winner gets sent to the International WorldSkills event in Abu Dhabi in 2017.

The SAIW Youth Welding Challenge will be held from 21-25 November after a series of regional trials. The WorldSkills SA competition will take place at the ICC in Durban from 16-18 January 2017 and the WorldSkills International competition is in Abu Dhabi from 14-19 October 2017.

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Efficient welding repairs in the cement industry

This article by Jürgen Tuchtfeld, Thomas Assiom and Issam Chiguer of voestalpine Böhler Welding, UTP Maintenance, describes welding applications for the cement industry where hardfacing applications of highly stressed components as well as repair welding of broken parts are part of the daily routine.

Handling bulk and abrasive material is routine in the cement industry. At each production step, beginning with quarrying of the raw material, the crushing and milling of the limestone up to the point of calcination of limestone, cement plant components encounter tough wear conditions resulting in significant abrasive wear. High-temperature corrosion and fatigue may also accelerate material degradation.

In this article some typical repair work is discussed, such as the repair of a rotary kiln tyre with special nickel base welding consumables and the hardfacing of typical crushing and milling equipment. Using optimally adapted welding consumables establishes welding as a cost effective maintenance strategy with long-term duty cycles.

Wear phenomena in the cement industry

Cement plants are subjected to very aggressive wear condition all along the production process with components in continuous contact with raw material, clinker or cement.

Abrasive wear: The three-body abrasive wear model is shown in Figure 1.

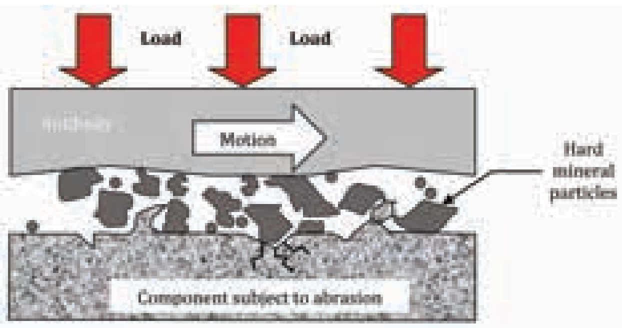

Figure 1: The three-body abrasion model.

The component subject to abrasion is worn due to the contact with mineral particles located between the component and the antibody (Figure 1). The abrasive wear on the surface is accentuated by the pressure applied by the antibody on particles at the interface. As mineral particles are much harder than the component material, several mechanism of abrasive wear can be observed. Due to friction and pressure, the interface particles may groove, plow or locally deform the surface of the component. The hardness, pressures, size and form of the interface material strongly influence the abrasion rate.

In practice, the wear system sketched in Figure 1 appears in vertical roller mills, for example. Here, the antibody would be a grinding roll, the component would be a grinding table and the interface material would be clinker or raw material. Interface particles are ground by comminution and not by direct contact with the metallic parts.

Materials with high hardness exhibit a higher abrasion resistance than soft materials. Moreover, the addition of carbides (chromium, tungsten, vanadium) increases the lifetime of a part exposed to abrasive wear. UTP welding consumables such as the stick electrode UTP 75 have carbide content of 80% by weight and are ideally suited for abrasive wear applications without impact.

Welding consumables	Chemical composition of the pure weld in wt%			
UTP Ledurit 61	3,5% C	1,0% Si	35% Cr	Fe bal
UTP 75	Fe CrC WC alloy			

Table 1: Chemical compositions of UTP abrasion resistant welding consumables, UTP 75 and UTP Ledurit 61.

Surface fatigue: Stresses applied under the tensile strength of a metal can lead to a decrease of its mechanical properties. A cyclic load can result in dislocation motion and pile-up. After a certain number of repetitions, a crack may appear. The continuous stress cycles favour crack growth until the bearing surface is not large enough to support the stress. Finally, the part completely breaks.

The phenomenon that leads to the break of a kiln tyre is slightly different. When a cylinder or a ball is rolling over a flat surface, the maximum stress concentration is not directly located at the material surface, but slightly under the surface as shown in Figure 2.

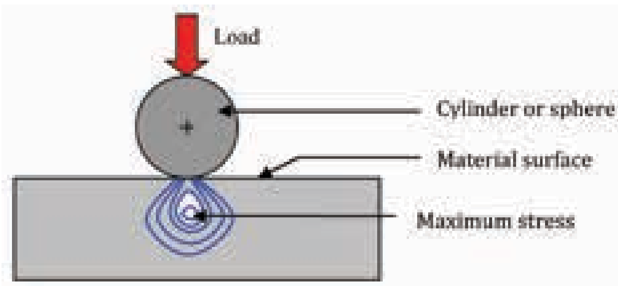

Figure 2: Stress distribution.

Cracks start in the vicinity of the maximum stress. These generally appear where a defect is already present such as casting defects or inclusion. This explains the formation of sub-surface cracks.

Impact wear: Impact wear occurs when a solid surface is submitted to percussive load due to another solid. As a consequence, two main effects occur in metallic materials: surface work hardening and material fatigue. Work hardening is described as a strength increase due to plastic deformation at ambient temperature. Tensile strength increases and therefore the hardness increases, but the ductility is reduced.

In cement plants, abrasive wear is always combined with impact wear so that abrasion, fatigue and work hardening contribute to the global degradation of a component.

Welded repair of rotary kiln tyres

Rotary kiln furnaces are long cylindrical ovens driven by support rollers located on both sides of the cylinder, Figure 3.

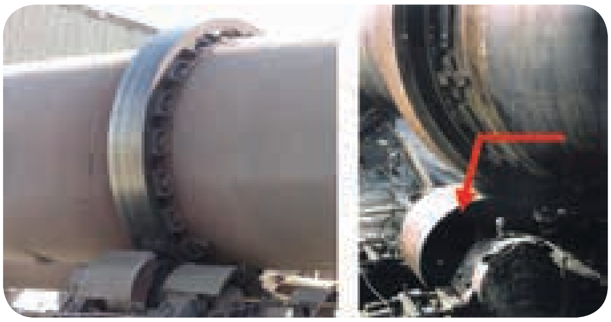

Figure 3: A kiln furnace at a cement plant and one of its supporting rolls.

Support rolls are in contact with a tyre fixed on the circumference of the rotary kiln furnace. Tyres are about 1.0 m wide and distributed at regular intervals all along the furnace surface. Tyres support the entire weight of the rotary kiln. This weight of more than 100 tons transfers local stresses onto the kiln tyre, which causes surface fatigue cracks.

Cracks are not visually detectable until they reach the surface for the reasons explained above. But with time, large pieces of the tyre surface spall off, causing damage as shown in Figure 4.

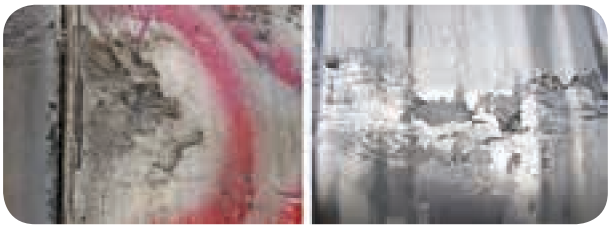

Figure 4: The disrupted surfaces of kiln tyres degraded by surface fatigue.

Kiln tyres are carbon steel cast components with high mechanical properties. The chemical composition and the strength of the base material are detailed in Tables 2 and 3.

C	Si	Mn	P	S	Fe
0,25 - 0,33	<0,60	1,2 - 1,6	<0,05	<0,05	Balance

Table 2: Typical chemical composition of the base material used for kiln tyres.

Mechanical properties	Base material
Tensile strength [N/mm^2]	>620
Yield strength [N/mm^2]	370
Elongation [%]	13
Hardness [HB]	<217
Impact value at RT [J]	35

Table 3: Mechanical properties of the base material types for kiln tyres.

Joint preparation and welding consumable choice:

Before welding, the damaged tyre must thoroughly prepared. The absence of cracks in the bevel is a crucial criterion for the repair quality and has to be checked using dye penetrant testing (PT). Moreover, the surface should be smooth and free of dust or other impurities to ensure a porosity- and inclusion-free weld deposit.

Since the repair has to be done on site in the dusty environment of a cement plant, welding areas have to be protected from external factors such as wind and rain, which negatively influence welding operations. The preparation of the welding area must also allow welders to have good accessibility to the repair area.

Repair of base materials with a chemical composition as given in Table 2 can be done using similar (iron-based) or dissimilar (nickel-based) welding consumables. Similar welding consumable, however, require preheating to avoid cold cracking, along with post-weld heat treatment to relieve stresses in the base material and in the weld deposit. Depending on the thickness of the tyre and on the chosen welding consumable, the preheating temperature will be at least 150 °C. Due to the huge size of the rotary kiln furnace, heat treatment is not feasible for obvious practical and cost-effectiveness reasons.

Nickel-based welding consumables, most notably, UTP 068 HH stick electrodes, present several advantages for kiln tyre repair. Most nickel-based alloys exhibit high ductility. This partly compensates for the lack of elongation in the base material and decreases risks of cold cracking while welding. The need for preheating of the base material can therefore be avoided.

The UTP 068 HH stick electrode also exhibits good mechanical properties and an extremely good resistance to hot cracking. Furthermore the strength of UTP 068 HH weld metal can also be increased by work hardening. While the deposition rate of SMAW is low compared to GMAW or submerged arc welding, the SMAW process has several decisive advantages, especially for welding on site:

- Previous generation power sources can be used, which are easily portable.
- There is no need of shielding gas.
- The slag decreases the cooling rate and shapes the bead. This minimises risks of undercut and, therefore, of cold cracking.
- Low dilution is achievable by using low amperage and small electrode diameters.
- Stick electrodes are weldable in all positions.

Welding procedure: Cold cracking is the main risk while performing a repair. The welding procedure has to be adjusted in order to expose the base material to the lowest possible levels of welding stress.

Welding starts with a rod diameter not exceeding 3.2 mm for the first layer. Firstly, the inside of the bevel has to be clad using a buffer technique in order to allow free shrinkage of the weld. The welding sequence is schematically represented in Figure 5.

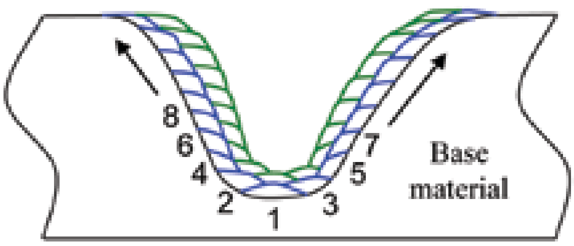

Figure 5: Welding sequence for the two first layers.

Welding starts with the first bead located at the bottom of the bevel. Following beads have to be alternatively welded on each side of the first bead until the complete bevel surface is clad. Subsequent layers have to be welded following the same welding sequence as for the first layer.

Low welding current is important to ensure low dilution with the base material and to keep the heat input low. Stringer beads and alternating the bead placement from one side to the other also contribute to limiting heat input.

After welding the first layer, electrode diameters larger than 3.2 mm can be used. Peening each bead is highly recommended to partly relieve shrinking stresses and to remove the slag. Each beach should be thoroughly brushed to guarantee the absence of slag inclusions inside the weld metal.

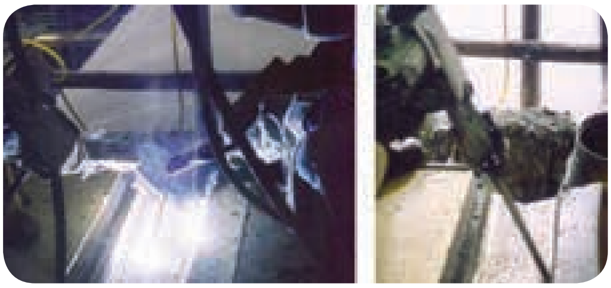

Figure 6: Repair welding of a kiln tyre using UTP 068 HH stick electrodes and peening of each bead following deposition.

After welding, the repaired area is machined to the original tyre shape. The procedure described can also be applied to repair kiln support rolls, which are subjected to similar mechanical loads and therefore experience a similar wear phenomenon.

Impact crusher hammer repair

Impact crushers are generally made of manganese steels and are widely used to reduce the lump size of raw materials. The addition of manganese to these steels results in high work hardening potential. The surface hardness dramatically increases during service, while the material inside the component remains ductile and crack resistant. The work-hardened surface provides excellent resistance to impact combined with moderate abrasion resistance. The internal material ductility, on the other hand, prevents the hammers from breaking in service. Worn hammers, however, must be replaced by new ones or repaired by welding.

Welding of manganese steels necessitates special precautions in order to restore the original material properties. Besides work hardening, manganese steels have a high thermal expansion coefficient, which leads to strong deformation while welding. The microstructure also tends to embrittlement when exposed to temperatures above 300 °C. As a consequence, the temperature has to be kept under a maximum of 250 °C for the duration of the repair.

Hammers are rebuilt to their original shape using welding consumables with similar chemical compositions to the base material, such as UTP CHRONOS, UTP 7200 or UTP BMC. The chemical analyses of manganese steels and matching welding consumables used for hammers are given in Table 4. The chromium additions in UTP BMC increase the mechanical strength and the resistance to abrasive wear. The pure weld metal deposit of UTP BMC has a hardness of approximately 250 HB. After work hardening, a surface hardness of 55 HRC can be obtained.

	C	Si	Mn	Cr	Fe
Base material	1.1	0.4	12	2.0	Balance
UTP CHRONOS	0.9	0.8	13	-	Balance
UTP BMC	0.6	0.8	16.5	13.5	Balance
UTP DUR 600	0.5	2.3	0.4	9.0	Balance

Table 4: Typical chemical compositions (%) of the base material and welding consumables for impact crusher hammers.

Welding procedure: Before welding, hammer surfaces are ground to remove dust and impurities. UTP BMC stick electrodes of 4,0 mm in diameter are used to rebuild the hammers to their original shape.

Stringer beads with an overlap of 50% are advised to obtain a smooth surface after welding. The last two layers are welded with the UTP DUR 600 stick electrodes. The weld deposit of UTP DUR 600 exhibits a martensitic microstructure resistant to abrasion and impact. The pure weld metal of UTP DUR 600 obtains 58 HRC directly after welding. UTP DUR 600 prevents the initially soft manganese steel deposit from an excessive material loss before the manganese steel has work hardened.

Vertical mill repair

The base metal for rollers and tables of a majority of vertical mills in the cement industry is Ni-Hard cast iron. For this material, which is difficult to weld, the welding procedure has to be strictly followed in order to reduce excessive levels of welding stresses.

C	Cr	Ni	Mo	S	P	Si	Mn	Fe
2.5-3.6	7.0-11	4.5-7	1.5 max	0.15 max	0.1 max	2.0 max	1.0 max	bal

Table 5: Typical chemical compositions (%) of the Ni-Hard cast iron base material used for vertical mills.

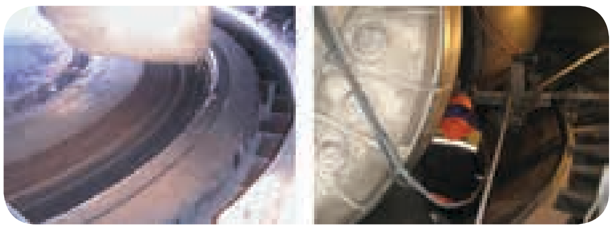

Figure 7: Left: Worn vertical mill table and roller and right: the flux-cored/metal cored welding equipment assembled for mill repair.

In this case, there is no joint preparation because the whole surface is hardfaced. This makes the mechanised cored-wire process ideal for an in-situ repair. All the more since welding consumables with high deposition rates are required to

A summary of the cement production process

Cement production starts with blasting and excavation of raw materials – mostly limestone (75-80%) and clay (20-25 %) – in a quarry. Raw materials are carried to the cement plant via conveyors, trains or dumpers; then crushed using jaw, roller or impact crushers. Crushing is followed by grinding using a vertical mill or ball mills, which reduce the raw material to powder (100 µm).

This powder is then preheated and introduced into a rotary kiln furnace, where calcination takes place, transforming the limestone powder into clinker. The clinker is then cooled, crushed and ground again. Gypsum, slag or fly ash may be added to obtain the final cement powder.

complete the repair within the short time frame of the plant shutdown. The chemical composition of Ni-Hard falls in the hypo-eutectic or eutectic zone. Inadequate wear resistance is predicted because small amount of the eutectic carbide, $(FeCr)_3C$ is produced and these have small grain size. For hard overlay weld metals to be highly wear resistant, they need to fall into the hyper-eutectic zone to the right of the eutectic line, which is high in carbon (C) and chromium (Cr).

Welding procedure: The absence of cracks is again very critical and has to be checked using PT. Following preheating to 60 °C, the first pass should be started at a distance of about 25 mm from the edge of each roller. This is to prevent bi-axial stresses, which can lead to spalling. Successive layers are gradually widened to fill the edge gap.

The interpass temperature should be kept to within 60-90 °C to achieve a tight cross-cracks pattern with cracks perpendicular to the bead every 10 mm. It is very important that the weld deposit has these small cracks.

The control of heat is the key success factor in this process. This can be achieved by apply cooling by means of compressed air on the deposited beads just after welding. Upon completion of the weld repair, the entire roller should be allowed to cool slowly using, if necessary, insulating blankets.


Figure 8: The repair of a vertical mill using SK 866-O (in situ) and (right) a mill roller hardfaced with SK A43-O flux-cored wire.

Cored wire welding consumables	Chemical composition of the pure weld in wt%				
SK 866-O	4,5% C	0,8% Si	24,5% Cr	-	Fe (bal)
SK 164-O	5,4% C	1,3% Si	27% Cr	-	Fe (bal)
SK 256-O	5,5% C	1,3% Si	25,7% Cr	-	Fe (bal)
SK A43-O	5,6% C	1,2% Si	20,2% Cr	6,7% Nb	Fe (bal)

Table 6: Abrasion resistant welding consumables for the mill roller repair.

Welding, once started, must be completed in a single operation without intermediate cooling to room temperature – and the interpass temperature must never be exceeded!

The hardness of the applied welding consumables is in the range of 60 to 63 HRc.

Conclusions

Kiln tyre degradation appears after several years and is characteristic of a surface fatigue wear. Specialised welding procedure must be applied to avoid any risk of cracking or defect in the repair. This can be done without preheating by using nickel base welding consumables such as UTP 068 HH.

Impact crusher hammers are subjected to high impact and abrasion wear. Welding with UTP BMC to build-up worn parts to their original shape and with UTP DUR 600 to confer good abrasion resistance enhances hammer lifetimes.

Vertical mills made from Ni-Hard cast iron, although difficult to weld, can be successfully repaired using UTP Maintenance's hyper-eutectic cored wire consumables, such as SK 866-O for the mill table and SK A43-O for mill rollers. Key to successful welding is tight control of pre-heating, heat input, interpass temperatures and cooling rates.

Repair welding of carbon steel pipe

that has experienced partial graphitisation during elevated temperature service

In this paper, presented at the 69th IIW Annual Assembly and Conference in Melbourne during July, PGH Pistorius and KJ Kruger from the SAIW Centre for Welding Engineering at the University of Pretoria, and CPM Orsmond from Sasol Synfuels report on an investigation into the graphitisation effects of plain carbon steels that have been in high temperature service for many years. The authors also investigate the viability of repair procedures to rehabilitate the mechanical properties of pipe made from these steels.

Plain carbon steels that are in service at elevated temperatures (typically 400-450 °C) for prolonged periods of time (typically in excess of 20 years) may experience graphitisation, often on the border of the visible heat affected zone (HAZ). This study aimed to determine the effects of this HAZ graphite on the mechanical properties of plain carbon steels. Additionally, it was required to evaluate whether repair welding of such graphitised material was viable.

A number of extended heat treatments were performed, in association with various joint configurations. A combination of gas-tungsten arc welding and shielded metal arc welding was used. Transverse tensile tests were performed but tensile test samples did not always fracture through the graphitised HAZ region. Failure that did occur in the graphitised HAZ resulted in a decrease in reduction in area; but no other mechanical properties were affected by the presence of HAZ graphite.

It was demonstrated that it is possible to perform repair welding on graphitised material using conventional welding procedures.

Introduction

C-Mn steels are widely used in processes where the materials are exposed to elevated temperatures and pressures for prolonged periods of time. This type of operating environment is typical for pipelines that transport superheated steam. Prolonged exposure (in excess of 10 years) of a carbon-manganese steel steam line subjected to moderately high temperatures (in the range of 400-450°C) results in a microstructural change known as secondary graphitisation.

Secondary graphitisation has been the cause of several catastrophic failures, the most notable of which was that of the Springdale Generation Station in the USA in 1943 when a high temperature steam pipe failed [1].

It is generally accepted that the presence of graphite reduces the tensile strength, ductility, and hardness of conventional C-Mn steels [2].

Graphite formation in carbon steel has classically been defined as the decomposition of the metastable cementite phase to form stable ferrite and graphite [3]. It has been demonstrated that steels with the same chemical composition, but different microstructures (induced through heat treatment) prior to graphitisation exhibit a rate of graphitisation that may vary significantly [4]. This observation indicates that the rate of graphitisation is likely to be determined by the stability of the carbides present in the steel, with martensitic and higher carbon containing carbides such as the chi phase decomposing faster and providing free carbon for graphitisation at much higher rates than cementite does. Much of the early literature reports successful attempts to graphitise various steels using prolonged heat treatments at temperatures ranging from 600-760°C [4], [5], [6], [7], [8].

Secondary graphite manifests in steels in two ways:

1. Homogeneously nucleated throughout the material – Figure 1.
2. Heterogeneously nucleated along the heat-affected zone of welded joints (HAZ graphite) – Figure 2.

Homogeneously nucleated graphite nodules are generally considered to have little to no effect on mechanical properties and are rarely (if ever) a concern.

Heterogeneously nucleated graphite nodules, on the other hand, tend to form along the heat-affected zone of welded joints. This form of graphite tends to form near-continuous planes that may affect mechanical properties.

The service temperature often determines whether graphitisation or spheroidisation occurs. Figure 3 illustrates that, for a particular steel, the transition temperature where spheroidisation becomes more favoured than graphitisation is at approximately 540°C. This transition temperature is difficult to determine and it is unclear which factors govern the transition temperature [9].

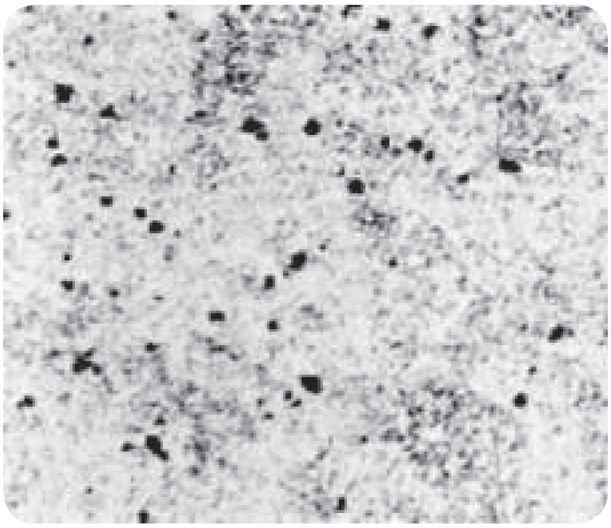

Figure 1: Randomly distributed graphite in a 1%C, 0.23%Si, 0.34%Mn steel that has been austenitised at 1 000°C, quenched and heat treated in air at 650°C for 100 hours [3].

Figure 2: HAZ graphite forming along the low temperature HAZ of a welded joint. [9].

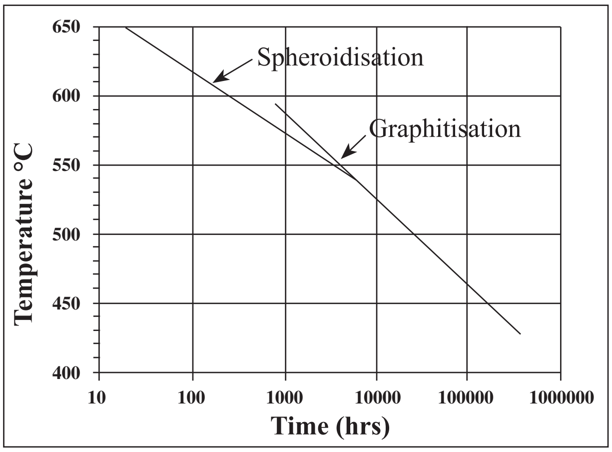

Figure 3: Time taken for half of the carbon in a 0.15%C steel to spheriodise or graphitise [10].

Experimental procedures

The objective of this study was to identify possible repair welding techniques that can be used to refurbish aging C-Mn steel pipelines that contain HAZ graphite.

The base material was a section of pipe (35 mm thickness) that was in service for 35 years at an average temperature of 427°C. The chemical composition and mechanical properties conformed to the requirements of SA-515 Gr 65. The nominal chemical composition was 0.22%C and 0.80%Mn. The material was removed from service during routine maintenance and found to contain a circumferential weld with significant amounts of HAZ graphite.

During the current study, several weld configurations were evaluated:

- The original material containing the graphitised HAZ.
- A new butt weld that had been welded on homogeneously graphitised base metal.
- A partial penetration double-grooved weld, which intersected the existing graphitised HAZ.

All experimental welds were heat treated before, after, or before and after welding at 635°C for 500 hours in an attempt to induce accelerated graphitisation and mimic long term exposure to elevated temperature. This temperature was selected to be on the low side of previously published graphitisation temperatures [4] to [8].

See Table 1 for details of the different welded joints.

Sample number	Heat treatment before weld	Joint design	Welding processes	PWHT
1	600 h at 635°C	Double V-groove	GTAW, SMAW	600 h at 635°C
2	600 h at 635°C	Double V-groove	GTAW, SMAW	12 h at 635°C
3	None	2 single V-grooves	SMAW	600 h at 635°C
4	None	None	None	None

Table 1: Welded joints evaluated during this study.

Figure 4 and Figure 5 depict the joint configuration prior to welding on the graphitised base metal and graphitised HAZ regions respectively.

These samples were tested in accordance to ASME IX, that is, two transverse tensile tests (with a rectangular cross section) and four transverse bend tests were machined from each weld [11]. The rectangular cross section tensile tests were supplemented with round tensile tests, for reliable observation of the plastic flow behaviour. Other tests included hot tensile tests (at 427°C), hardness profiles as well as weld metal and HAZ Charpy impact tests at room temperature. Extensive microstructural evaluation was performed using optical and scanning electron microscopy.

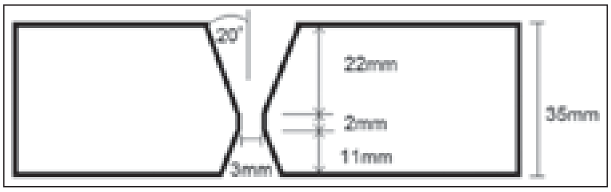

Figure 4: Full thickness groove preparation for graphitised carbon steel (joint preparation for samples 1 and 2).

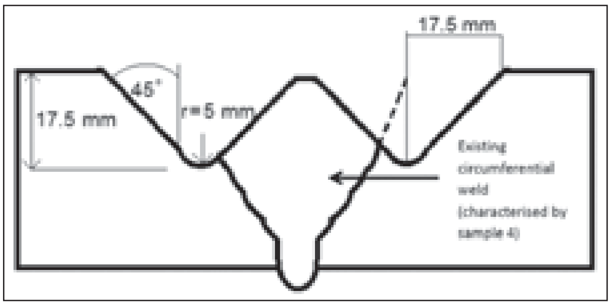

Figure 5: Half thickness groove preparation machined around pre-existing circumferential groove weld (sample 3).

Results and discussion

The results of the tensile test can be seen in Table 2 (rectangular cross section) and in Table 3 (round cross section). In most cases, the tensile test coupon failed in the base metal. Both tensile samples with a rectangular cross section from sample 4 (as received) failed in the HAZ graphite – Figure 6. It should be noted that the tensile strength of this sample was similar to that of other samples that had not failed in the HAZ graphite (Table 2). For the tensile samples with a round cross section, the reduction in area was usually between 69 and 74% (Table 3). When the fracture surface intersected HAZ graphite, the reduction in area was 44% (Table 3).

No other tensile properties were affected by the presence of HAZ graphite. The impact toughness was, on average, 218 J for the weld metal. The average HAZ toughness was 137 J. No other mechanical properties (such as the hot tensile strength, the bend angle, or the hardness) were affected by the presence of HAZ graphite.

Sample number	Yield strength (MPa)	Tensile strength (MPa)	Location of failure
1	263	410	PM1
	245	416	PM
2	268	416	PM
	269	418	PM
3	259	418	PM
	277	419	PM
4	272	451	HAZ
	277	450	HAZ

Table 2: Tensile results as measured using transverse tensile samples with a rectangular cross-section.

Sample number	Yield strength (MPa)	Tensile strength (MPa)	Location of failure
1	407	70	PM
	410	69	PM
2	420	70	PM
	412	71	PM
3	415	70	PM
	412	44	HAZ
4	452	74	PM
	447	69	PM

Table 3: Tensile results as measured using transverse tensile samples with a round cross-section.

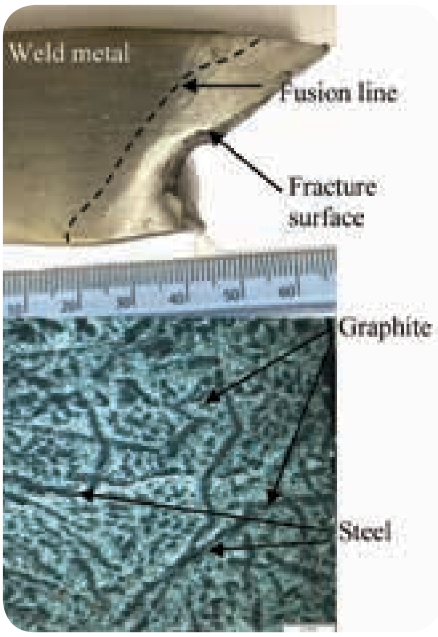

Figure 6: Failure of sample 4 through the graphitised HAZ. a) the fracture profile in relation to weld metal. b) the fracture surface (original magnification 8×).

Tensile test results showed that all samples that experienced prolonged heat treatment displayed a reduction in tensile strength of 30 to 40 MPa. The reduction in tensile strength can be explained by pearlite spheroidisation during prolonged exposure at 635°C – Figure 7. All samples that experienced

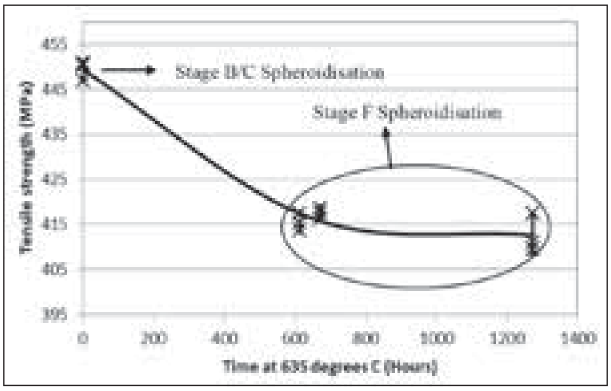

Figure 7: Effects of prolonged heat treatment (at 635°C) on the tensile strength of materials and the degree of spheroidisation as described by Toft and Marsden [12].

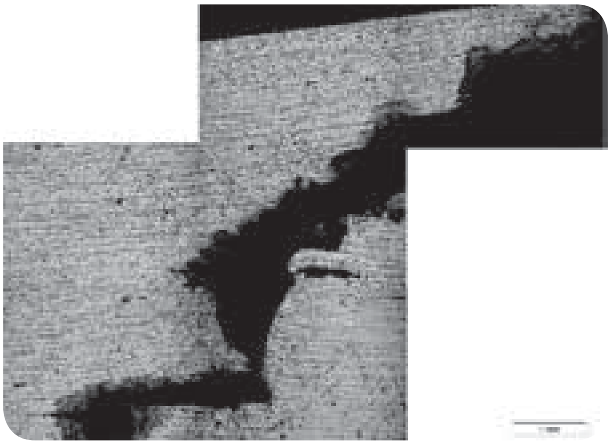

Figure 8: Step-like fracture of rectangular tensile test coupon transverse to as-received circumferential weld (sample 4).

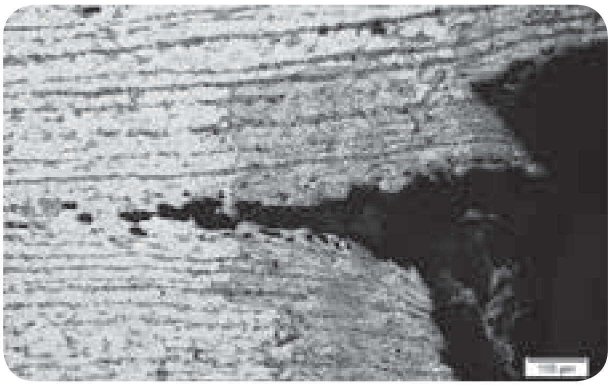

Figure 9: Higher magnification image of the fracture surface visible in the lower left hand corner of the previous image (sample 4).

the prolonged heat treatment were spheroidised. No graphitisation during the extended heat treatment at 635°C was observed, consistent with the published work ([10], Figure 3).

A cross section of the graphitised fracture surface can be seen in Figure 8 and Figure 9. The fracture plane seems to develop by alternating rupture through the plane defined by the graphite nodules and tearing through the ferrite-pearlite structure that does not contain graphite.

Figure 10 is a high magnification image of a graphite particle etched from the metallic substrate (4% Nital for five minutes), showing the complex substructure of a graphite nodule.

Conclusions

- The presence of HAZ graphite observed in this study had no effect on the mechanical properties of the material, except for the decrease in reduction in area when the tensile test

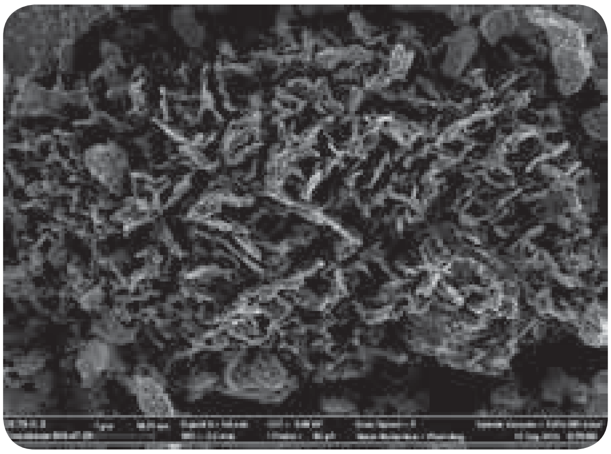

Figure 10: Complex structure of graphite inclusion, visible on an over-etched surface (high resolution SEM image, original magnification 26 790×).

coupon failed through the graphitised HAZ.

- Prolonged heat treatment at 635°C, at times for up to 1 200 hours, resulted in spheroidisation, but not in noticeable graphitisation.
- Repair welding on graphitised material can be performed successfully.

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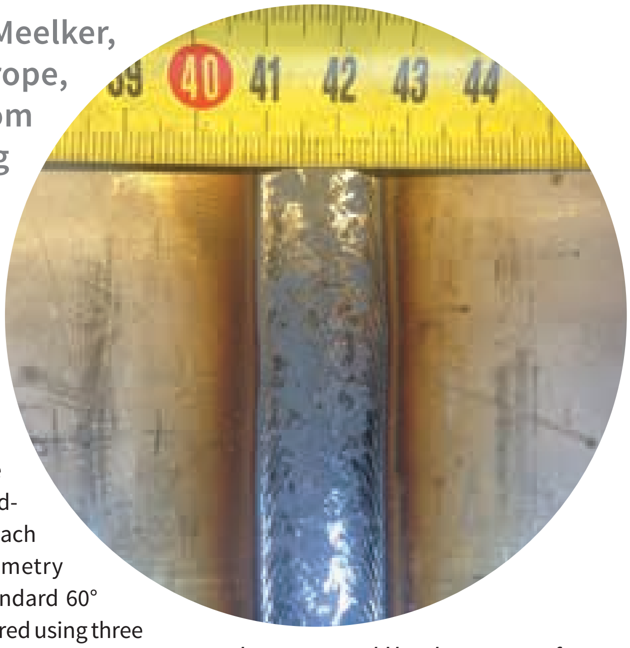
Rapid-X welding process technology

In this article by D Ritsema, R van Klooster, H Meelker, D Senogles and P van Erk of Lincoln Electric Europe, new Rapid-X™ welding process technology from Lincoln Electric is shown to improve welding productivity for stainless steel process pipe, increasing welding speed by 15% while reducing heat input by 20%.



The cap pass weld bead appearance from Lincoln Electric's Rapid-X process.

It is well known that the deposition rate of traditional constant voltage (CV) MIG welding can be increased simply by increasing the wire feed speed. However, this is only feasible if the welding process can be kept stable enough for high quality welds to be produced. Also, higher deposition rates are often accompanied by higher arc energies, which can impact negatively on the mechanical properties of both the base material and deposited weld metal.

The new synergic pulsed-MIG welding process from Lincoln Electric, Rapid-X™, has been developed to allow higher usable wire feed speeds compared to conventional pulsed-MIG welding. The Rapid-X process operates with a shorter arc length, which enables significantly higher travel speeds and therefore significantly reduced arc energies. In addition, the lower arc voltages associated with Rapid-X mean that the process is more resistant to undercut.

In this study the Rapid-X process was compared to conventional pulsed-MIG welding and flux-cored arc welding (FCAW) for mechanised fill and cap pass welding of stainless steel process pipe. All root-pass welding was carried out using Lincoln Electric's proprietary STT® process.

STT® + Rapid-X™		
Test	**Result**	**Comment**
Cross weld tensile test	583 MPa	Break pipe
	565 MPa	Break pipe
Root bend	Acceptable	No defects
	Acceptable	No defects
Face bend	Acceptable	No defects
	Acceptable	No defects
CVN -196°C	34 J avg	Size 5×10 mm
LE -196°C	0.96 mm avg.	

Table 1: A summary of the mechanical rest results for the pipe butt welds completed using different process combinations.

Welding procedures

ASTM A312 TP304L Sch. 40S (323.9 OD×9.53 mm) pipe was used for all welding procedures. In each case, the joint geometry was an industry standard 60° V-joint that was secured using three bullet tack welds.

All the consumables uses were standard, commercially available grades. The solid-wire welding procedures were completed using an ISO 14175-M12 shielding gas (96% argon, 3% carbon dioxide and 1% hydrogen). In the case of flux-cored arc welding, the shielding gas applied was an ISO 14175-M21, consisting of 80% argon and 20% carbon dioxide.

For STT root pass welding, the root-side was protected using an ISO 14175-F5 backing gas of composition 95% nitrogen and 5% hydrogen. A Walter Schnorrer WS 300 system was inserted into each pipe joint for gas purging prior to and during the welding of all passes.

The welding parameters for each process were carefully optimised to give the best welding performance for this particular application. All STT root pass welds were deposited manually, in rotated pipe, using a non-synergic welding mode where peak current, background current and wire feed speed could be changed independently. Manual STT welding allowed the welder to quickly accommodate for variations in root gap as well as deal with any 'hi-lo' in the joint set-up.

A mechanised welding solution was applied for all fill- and cap-pass welding, again in rotated pipe. Here the welding operator could adjust the contact tip to work distance, the wire position in the joint, as well as the weave width during welding. As can be seen in Figure 1, this resulted in a cosmetically appealing weld bead that was optimised from the standpoint of productivity and quality.

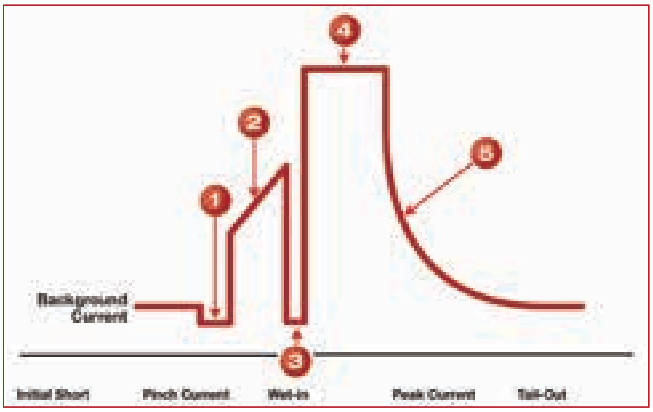
Each pipe butt weld was subjected to mechanical testing to examine the cross-weld strength via tensile tests, the ductility and fusion via bend tests, and the weld metal toughness via sub-size Charpy V-Notch tests. In the case of austenitic stainless steel weldments, lateral expansion is often specified as a code requirement and so this test was included for completeness. The results for all these mechanical tests are summarised in Table 1.

Welding productivity

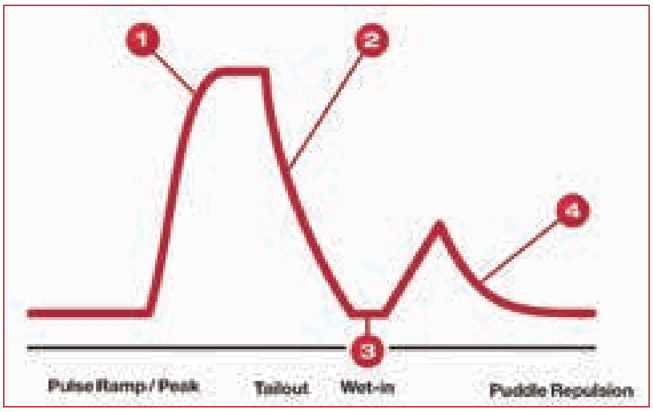
Each butt weld consisted of a manual STT root pass together with one mechanised fill- and cap-pass. A summary of the actual travel speed and calculated arc energy for the weld passes is provided in Table 2 and in Table 3, where the same data has been converted to show percentage changes to compare Rapid-X to the other welding processes.

It can be seen that, on average, the Rapid-X process resulted in travel speeds that were 15% higher compared to conventional pulsed-MIG welding and flux-cored arc welding in this investigation. The higher travel speeds and lower arc voltages associated with Rapid-X yielded, on average, a 20% reduction in arc energy.

The significantly lower arc energy of the Rapid-X process resulted in a much



The STT waveform.



Rapid-X waveform.

narrower and less intense heat-tinted zone on the root-side of the pipe.

The Rapid-X weld passes were deposited using higher wire feed speeds compared to conventional pulsed welding, however, these speeds were not associated with higher welding currents. This is another key advantage of the Rapid- X process.

Lincoln Electric's advanced power sources

The welding processes used in this comparative study are available as standard from Lincoln Electric when using Power Wave® S350 or S500 power sources in combination with digital STT® modules. A short summary of the characteristic features of these welding processes are presented below.

STT is a waveform-controlled, short circuit transfer process that allows welding current to be set independently of wire feed speed. The arc voltage is continually 'sensed' so that timely and precise amounts of current can be delivered to the arc (Figure 3) thereby reducing spatter and fume significantly. STT produces sound root welds with low heat input, but without the risk of lack of fusion.

Since an STT root bead can approach 5.0 mm in thickness, the first fill pass can be accommodated using higher energy processes, such as submerged arc welding, without the risk of burn-through. Typically, an STT root bead can be deposited four times faster than tungsten inert gas (TIG) welding. In addition, the time required for a welder to learn to produce sound welds with STT is significantly reduced compared to TIG welding.

Rapid-X is a waveform-controlled, synergic pulsed welding process that operates with a shorter arc length compared to both traditional constant voltage (CV) spray arc welding and conventional pulsed MIG welding. The Rapid-X process actually uses the STT module to provide low current wet-in (Figure 5) to produce spatter-free welds.

Peak current values are carefully controlled to ensure sufficient energy to allow high travel speeds while maintaining excellent sidewall fusion and penetration characteristics. Originally developed for high-speed lap joint welding in the automotive industry, Rapid- X is now being applied for welding applications in a wider range of market sectors.

Unlike constant voltage (CV) spray arc welding where current values remain continually high, conventional pulsed-MIG welding involves rapid modulation of the current between (high) peak and (low) background values to produce a tightly controlled droplet transfer regime in which individual droplets are 'fired' across the arc. The result is a very stable arc, with lower heat input, that facilitates all-position welding capability on both thick and thin materials.

Conclusions

In this study a new synergic pulsed-MIG welding process from Lincoln Electric, Rapid-X, has been compared to conventional pulsed-MIG welding and flux-cored arc welding (FCAW) for mechanised fill- and cap-pass welding of stainless steel process pipe.

In this particular application, Rapid-X was found to offer a 15% increase in travel speed while simultaneously reducing arc energy by 20%. Both of these results are directly related to the lower arc voltage and fast following characteristics inherent in Rapid-X technology.

The significantly lower arc energy of the process was found to give a much narrower and less intense heat-tinted zone on the root-side of the pipe. Such effects are expected to have a positive effect in terms of preserving corrosion resistance for stainless steel materials.

	Welding speed (cm/min)		Heat input (kJ/mm)	
	Fill	Cap	Fill	Cap
Rapid-X	33,5	29,8	0,9	1,0
Pulsed MAG	27,0	27,8	1,2	1,2
FCAW	27,4	28,4	1,2	1,3

Table 2: A summary of the actual travel speed and calculated heat input for weld passes completed using different processes.

	Welding speed		Heat input	
	Rapid-X vs Pulsed	Rapid-X vs FCAW	Rapid-X vs Pulsed	Rapid-X vs FCAW
Fill	+24%	+22%	-25%	-28%
Cap	+7%	+5%	-12%	-19%
Average	+16%	+14%	-19%	-23%

Table 3: Percentage changes in travel speed and heat input energy of Rapid-X compared to the other welding processes.

STT root-pass welding.

Mechanical test data shows that Rapid-X is capable of producing high-strength, high-toughness, and high-quality weldments that comfortably meet typical code requirements for cryogenic welding applications.

Welding skills development

Afrox, in partnership with non-profit upliftment organisations, POPUP, has established and equipped a 12-bay welding school at the new Sipho Nkozi Community House Building Training Centre in Soshanguve. *African Fusion* talks to Johan Pieterse about the development.

"Developing skills across industries will play a key role in developing South Africa's economy and training welding artisans locally will increase opportunities within the country's workforce," says Afrox's Johan Pieterse.

"As a leading industrial gases and welding equipment supplier in sub-Saharan Africa, Afrox is establishing its first tertiary welding facility as our contribution to the upliftment of our unemployed youth and towards the development of entrepreneurial skills," he adds.

Launched in partnership with POPUP (People Upliftment Programme), at the new Community House Building Training Centre in Soshanguve, South Africa. The new school has 12 fully equipped welding bays and is suitable for training in shielded metal arc welding (SMAW); gas metal arc welding (GMAW); tungsten inert gas welding (GTAW); and oxy-fuel welding and cutting processes.

The aim of the Soshanguve-based facility is to support various technical up-skilling programmes with an emphasis on welding as an in-demand route to sustainable careers.

Says Pieterse: "Quality training and development arise from good training infrastructure. The Afrox team, therefore, leaped at the opportunity to build a top class training facility to accommodate 12 students at a time.

"This will be supported by our skills development training programmes, which will contribute towards formal qualifications. We kicked off the first programme recently and look forward to certifying our first trainees in, the class of 2016.

Afrox has developed a comprehensive set of in-house welder-training course material in an attempt to better match the real needs of South African Industry for artisans that have a thorough grounding in basic welding theory and the knowledge and ability to produce consistently high quality welds in practice. "We are very proud of the quality of the material we have produced," Pieterse tells *African Fusion*. "The material is easy to read and understand and we have had a very positive response from the welding industry about its suitability and usefulness.

"We intend to pursue CHIETA accreditation for the material and we hope it will be adopted by other welding training schools in the future," he adds. "Afrox intends to establish continuity by training instructors and partnering with like-minded organisations, such as the Southern African Institute of Welding (SAIW), to ensure that we continue to develop welders trained to international welding standards, creating jobs across sub-Saharan Africa."

Says SAIW executive director, Sean Blake: "We are acutely aware of the need for more and better skilled welders in South Africa. We are therefore happy to support initiatives such as these, especially if they create pathways for unemployed people to become accredited to International (IIW) standards."

Enhancing local skills is the driver behind Afrox's skills development programme, which has now been extended to schools to attract and inform pupils of the advantages of a technical career and encourage more young learners to take welding further at a tertiary level.

As a result, Afrox has partnered with the Department of Education, supporting its Technical School Recap programme under Mechanical Technology. The Afrox-supported strategy is focused on de-mothballing welding facilities, equipping them with advanced technology equipment and upskilling educators to facilitate training.

To date Afrox has upgraded and equipped 14 technical schools nationally, trained more than 40 teachers in the four main welding processes and communicated the importance of technical skills qualifications at selected launches in the major provinces.

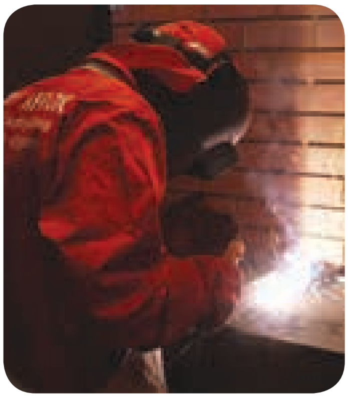
The People Upliftment Programme

People Upliftment Programme (POPUP), is a non-profit organisation with a holistic approach to the upliftment of under-privileged communities, rendering services to all persons living in Tsh-

Left: The Afrox-sponsored Welder Training Workshop has 12 fully equipped welding bays and is suitable for training in shielded metal arc welding (SMAW); gas metal arc welding (GMAW); tungsten inert gas welding (GTAW); and oxy-fuel welding and cutting processes. Right: The first programme was concluded in July and the first 12 trainees have successfully concluded a basic welder training course.

for job creation

Above: Afrox has developed a welding course along with a comprehensive set of in-house welder-training course material (inset) in an attempt to better match the real needs of South African Industry for practically skilled and knowledgeable artisans. Left: Practical welder training taking place at POPUP's new Sipho Nkozi Community House Building and Training Workshop in Soshanguve.



wane in the Gauteng province of South Africa. Currently POPUP's main centre is situated in Salvokop, Pretoria, with a second centre in Soshanguve.

At present POPUP offers nine SETA accredited market related skills programmes to unemployed people. At Salvokop these include:

- Adult education and training, English literacy and numeracy.
- Personal growth programme, life skills.
- Hospitality services, (cooking, cleaning and laundry).
- Home-based care.
- Project and enterprise development.
- Sewing.

In addition, non-accredited entrepreneurial skills programmes in basic computer skills and Cookie Jar Training (Baking for Profit) are available.

With the expansion to Soshanguve, additional skills programmes will be presented soon, with the welding programme being among these. The POPUP Soshanguve Centre focuses on technical skills training, initially in the building construction field, with Community House Building, Forklift Driving and Plumbing already available as accredited programmes. Computer and Office Administration and Project and Enterprise Development are also mooted, while Basic Carpentry; Basic Plumbing; Basic Painting; and now Welding are available on a non-accredited basis.

Partnering with POPUP comes with benefits for supporting companies: BEE score-card points, through Socio Economic and Enterprise Development Involvement; Tax benefit due to POPUP's registration as a Public Benefit Organisation (PBO) with Section 18A status; and training benefits for companies or employers wishing to upskill lower level staff and benefit from rebates on offer from the Skills Development Fund.

POPUP has trained 4 100 learners and placed 77% of them in employment over the past seven years. It also invests and supports learners who want to start their own business ventures, providing a one-year incubation phase on POPUP premises and a facilitator to monitor quality and standards.

Afrox to showcase tailor-made solutions at Electra Mining

Interactive live demonstrations by the 'Kalahari Scientist', aka Jonathan Hartley, is sure to attract huge attention at the Afrox stand at Electra Mining 2016, the biggest mining, industrial, electrical and power trade show in Southern Africa.

The not-to-be-missed, exciting and interactive science demonstrations by the 'Kalahari Scientist' will be a real education in the properties of hydrogen, oxygen and nitrogen; as well as LPG and propane.

Afrox, southern Africa's leading industrial gases and welding equipment supplier, will also showcase its move to solutions tailored for individual customers and will be joined on its stand by sister company, Linde Engineering South Africa.

"Our product and services offering has shifted to focus on providing individual customers with bespoke solutions for their operations," says Dhevan Moodley, head of Afrox's Integrated Customer Solutions. "Our customers are under constant pressure to improve their efficiencies and Afrox recognises that to add value means understanding their operations and processes, so that we can offer services and products that are meaningful and beneficial to their needs."

At Electra Mining, Afrox will focus on customers in the mining, petrochemical, transport, fabrication and power generation sectors. It will also showcase its advances in Genie cylinders, automated welding, recycling of HFCs and the latest individual cylinder control management and tracking solution.

Afrox will also highlight the lifesaving attributes of its AfroxPac 35i, a closed-circuit, self-contained oxygen breathing apparatus designed for escape from oxygen-deficient atmospheres.

AfroxPac 35i, which in the South African mining sector is used for, on average, one million man-hours every day, uses an efficient bi-directional re-breathing system in which exhaled gas makes two passes through the carbon dioxide removal/oxygen generation canister before the oxygen-rich gas returns to the user. The ergonomic design makes it suitable to be continuously carried by people working in dangerous atmospheres.

Visitors to the stand will be able to view other trusted mining industry mainstays including Afrox's BlueBox and RedBox heavy duty oxy/acetylene kits, and will have the opportunity to discuss their needs with Afrox's professional technical team.

Afrox will be at Electra Mining Africa 2016 in Hall 6, Stand D20 of the Nasrec Expo Centre from 12 to 16 September.

Kalahari Scientist Jonathan Hartley and his assistant Molehfi McLean will be wowing visitors to Electra Mining Africa 2016 with Interactive live demonstrations

Modern tank farm construction using EGW and AGW processes

***African Fusion* talks to Jannie Bronkhorst (right) of Renttech about tank farm construction using mechanised submerged arc, automatic girth and electrogas welding processes – and Renttech's total packaged solution, from project inception to the completion of the final weld.**

In the past, because tank farms are built on site and have to withstand the elements, SMAW electrodes were used for almost all of the weld seams of fuel tanks. "Gas shielded processes were not suitable and gas is not always easy to get, particularly in Africa. So the labour-intensive stick welding process, which is associated with many stops and starts and a high potential for discontinuities or defects, was generally used," says Bronkhorst.

"Today, we employ mechanised processes wherever possible, which are much faster, less prone to defects and offer significantly lower total project costs and greatly improved return-on-investment. Three factors govern the success of projects such as tank farm construction: time, quality and cost, and the mechanised approach improves all three," he argues.

Fuel tanks can be sized from 6,0 m in diameter to 150 m. The ones currently under construction in the Port of Beira in Mozambique have a diameter of 37 m and a height of 22 m, each with a capacity of 20-million litres. The Beira fuel terminal with five of these tanks is being built to support needs across Africa for petrol, diesel and jet A1 fuels.

"Every tank gets erected on a base. The ground is piled and different layers of reinforcing are put in and compacted down, with a final layer of bitumen on the surface completing the civil side of the construction project," says Bronkhorst.

"The steel tank is then built on top of the piles. The floor plates are laid down first, tapering down towards a conical drain at the centre of the base. This separates out any water that gets into the tank, because fuel floats on water," he explains.

The floor is made up of flat plates, curved at the corners and lapped over each over in an interwoven pattern. "The joints are all lap joints, but on thicker material they can look a lot more like fillet welds," he notes.

Before welding begins, the annular baseplate ring is placed around the tank underneath the floor, "but this ring does not get welded until the tank is completed," Bronkhorst tells *African Fusion*.

Commenting on replacing the use of stick electrodes, he says: "Today we employ a submerged arc process for the base, using Lincoln LT7 tractors and Lincoln Flextec 650 power sources. But it gets very hot on the tank floor, so when welding relatively thin plates, it is critical to weld them in a pre-set sequence to avoid distortion, bowing and buckling.

"We start with the longitudinal welds and we complete diagonally opposite seams to immediately counterbalance any distortion from the previous weld pass. Only after completing the longitudinal seams do we return to complete the cross seams.

"Once the floor plate is compete, welding of the 'strakes' begins. These are curved plates 2.4 m high by 10 m long, which form the cylindrical walls of the tank's shell. Each plate has a built-in curvature, depending on the diameter of the tank, and plate thicknesses vary from bottom (thicker) to top," he says.

There are two ways of building these large tanks, according to Bronkhorst.

All Time Welding's EGW and AGW welding systems are ideal for mechanising welding. According to Bronkhorst, the mechanised approach improves all three factors governing success: time, quality and cost.

The first and most traditional is the 'bottom-up' technique, which means the thickest strake sections are welded first. Then thinner sections are added until the height required is reached. Walkways, a wind girder – a reinforcing ring connected via knee braces to stiffen the top section of the tank – and a roof will then be added.

The alternative method is the 'jack-up' method, or the 'top-down' method. "The first ring of strakes is assembled – supported by temporary fishtails mounted onto the floor – and then tacked together. The vertical seams between the plates of the strake are then welded using the EGW process until the first ring of strakes is complete," Bronkhorst explains, adding that this section will end up being the top section and is therefore constructed from the thinnest material.

The roof, which is an aluminium structure, is immediately bolted on at the height of one strake. Then the whole ring and its roof are jacked up to allow another ring of strakes to be inserted below.

"This method has some access advantages, because all the welding work is done closer to the ground. Hooking up an EGW or AGW system and all of the peripheral equipment needed to complete a seam 22 m in the air is complex, so by keeping the bulk of the work at a height of 2.4 m, access is much easier," says Bronkhorst.

The EGW process for vertical seams

Electrogas welding (EGW) is a single pass welding technique developed for completing vertical seams in plate thicknesses from 10 to 40 mm. "We can use a gas-assisted flux-core wire or a self-shielded/gasless wire such as Lincoln Electric's NR431, which is designed specifically for EGW welding," continues Bronkhorst.

"With the gas-assisted process, CO_2 shielding is used and we find that this does result in slightly better mechanical properties – and we have done the tests. It also produces less fume and, although one has to add a gas cost, the gas-assisted process is a little less expensive," he adds.

The EGW carriage, due to its wind-shielding frame, also protects the gas shielding from wind, preventing porosity, and it shelters the operators. Describing how the process works, he says that water-cooled copper backing bars with a weld-profile groove are wedged onto the inside of the tank to cover the full length of the strake seam.

Above: The 'jack-up' method, or the 'top-down' construction method has some access advantages, because all the welding work is done closer to the ground. "By keeping the bulk of the work at a height of 2.4 m, access is much easier," says Bronkhorst.

Right: A specialised flux belt is used to support the granulated flux around the outside of the strake while welding proceeds. The end result is a high quality butt joint completed in the 2G position.

On the outside surface, a spring-loaded travelling copper shoe, which is attached to a welding tractor, is pressed against the seam surface, forming an enclosed 'mould' for the weld metal. The welding head feeds wire into the top of the cavity striking an arc, which fills the joint with molten metal.

Making this process very simple and elegant, the welding head and the connected copper shoe is moved up the seam so as to keep the arc voltage constant. As the joint fills, at a rate dependent on the chosen wire feed rate, the voltage detected tends to drop, which triggers the tractor to move up. This is known as a closed-loop voltage sensing process.

"So the travel speed does not have to be set. To make the process faster, all that is required is to increase the wire feed rate, within the current limits of the power source being used, and the travel speed will automatically increase to fill the joint faster," Bronkhorst explains.

Comparing the process to SMAW, he says: "If welding a vertical strake seam on 20 mm plate by hand, the stick operator will take two days to complete the whole seam. The EGW process can do it in under an hour – and we once measured a joint on 20 mm plate, 2.4 m high being completed in just over 47 minutes," he notes.

"On a tank of 116 m in circumference, the use of 10 m strakes gives 11 vertical seams that have to be welded," he calculates. "On a strake height of 2.4 m, that gives a total vertical welding length of 26.4 m per ring and for every manually welded pass, one would have 132 stop-starts per strake joint. If, on average, five runs are required to completely fill a joint using SMAW, then 660 stop-starts have to be blended per ring section or nearly 6 000 for all of the vertical seams on the tank," Bronkhorst estimates

"For manual welding, 10 or 20 welders will be required, each with their own machines and dedicated grinders. This to keep up with an EGW machine that can easily complete 11 strakes in one day," he points out, adding that the EGW

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process also eliminates the need for any back grinding.

AGW for the horizontal seams

An automatic girth welding (AGW) system from All Time in China is used to weld the horizontal seams between completed rings of strakes. "This is a submerged arc technique specially developed for welding horizontal girth welds of large tanks. The whole AGW system, which carries all of the welding equipment and two operators, travels around the outside of the tank to weld the long horizontal seams.

"Driven by dc motors, the AGW welding station is driven around the tank shell to close the seams between strakes. A specialised flux belt is used to support the granulated flux around the outside of the strake while welding proceeds. The end result is a butt-joint completed in the 2G position – a horizontal seam on a vertical structure – generally completed from the outside only," Bronkhorst tells *African Fusion*.

Again highlighting the advantages of the jack-up system, he says that the carriage rests on wheels against the shell and is driven from a ring system around the tank base. "If jacking up, cranes are not required to move the AGW welding system as it is supported on the ring at ground level – and all the seams are welded at about the same height. If constructing the tank from bottom up, then the cart would have to be driven off the top at increasing height. This has safety, wind and logistical implications that all complicate the process and add to overall costs.

"From a quality point of view, all of the inspection can also be done at the lower level and any repairs completed immediately, before jacking up," he adds.

Doing the comparison between AGW and SMAW, Bronkhorst says: "Using 4.0 mm electrodes, about 1.9 kg/h of material can be deposited and a 350 mm electrode can, perhaps, complete 250 mm of welding per electrode. On a 37 m diameter with nine rings of strakes and a circumference is 116 m, there will be 580 stop-starts for each welding pass on each section. Each ring will have 5 220 stop-starts per pass and, if we take an average of four passes per seam, that amounts to over 20 000 stop-starts on the horizontal seams before the tank is completed," Bronkhorst informs *African Fusion*.

Repeating the three factors governing success: time, quality and cost, he argues that every stop-start when using a stick electrode takes up time in blending the weld bead via grinding. The quality is affected due to discontinuity risks and because of skills shortages and the inconsistency of manual welding. Also, time costs money and non-welding activity such as grinding or repairing a discontinuity adds to the project cost.

"By using the AGW process, we can complete a full 360° girth weld without stopping. Productivity-wise this cannot be compared to the manual process. It is at least 20 times faster. And while it is associated with a little more capex, the investment is a 'no-brainer' relative to the contract completion costs," he says.

Overcoming challenges in Africa

From a skills perspective, Bronkhorst says that it used to be possible to take trained and experienced specialists from South Africa, China or Europe to a project in Africa. "But everywhere you go now, local people have to be employed on the job and these resources generally require upskilling and training.

"For the construction of the tank farm in Beira, we were able to train six local operators, in-situ, and all of them passed the training course. The best and most experienced welders are not ideal for mechanised welding and they are better used elsewhere, anyway. All that is needed is someone who understands the process and the art of welding. The mechanised system takes care of the physical manipulation, allowing the operator to adjust for the inconsistencies and to monitor and control the welding parameters and quality," he says.

The quality and consistency of completed welds improves significantly and because of the more continuous nature of the processes used, project time improves and the costs drop.

In addition, the power draw of twenty welders in a tank versus two AGWs and an EGW working simultaneously is also favourable. "In Beira, a 600 kVA standby generator is available but the construction site is supplied by a 250 kVA transformer. In the past, the contractor told us, they needed a 450 kVA supply to power the equipment needed by all of the manual welders, their helpers and grinders," Bronkhorst adds.

Driving tank farm growth, he cites a growing need for fuel, oil and gas across Africa to support the industrial and infrastructure growth that is still taking place and is sure to accelerate. "Storage service providers are critical as links between exploration, production and downstream refining and marketing. This results in a growing need for more tank farms," he predicts.

Above: A Lincoln LT7 tractor and Lincoln Flextec 650 power source is being used to complete the floor-to-shell outside circumferential weld using the submerged arc process. The same equipment is used to weld the tank base. Left: A completed AGW weld on a 20 mm bottom strake.

"We at Renttech are proud to be an authorised distributor for All Time Welding's EGW and AGW welding systems. With our national footprint of 22 branches in South Africa, our growing pan-African presence and our extensive experience in the petrochemical industry, along with All Time Welding's customised products and experience in tank construction, we are in an ideal position to offer the latest and most appropriate technology to tank fabrication contractors.

"Renttech also understands the unique challenges that these projects present in Africa. With our rental offering, we have the capacity to equip sites with all the peripherals needed on construction sites and our internationally trained staff is available to ensure full technical support from planning to the completion of a project," he concludes.

ESAB's new Rebel and other innovations

ESAB South Africa will be launching its new Rebel™ multi-process welding machine into southern Africa at Electra Mining Africa (EMA) next month. *African Fusion* talks to Kim Brightwell (right), sub-Saharan Africa country manager and marketing director for ESAB Middle East & Africa, about this and other innovations being showcased in 2016.

According to Brightwell, the Rebel welding machine is ideal for professional and non-professional welders. "ESAB is to offer two Rebel models, the full-featured Rebel EMP 215ic and Rebel EM 215ic which will be launched later. The Rebel EMP 215ic includes MIG, sMIG and flux-cored welding outputs and features an innovative user interface with a large TFT display to provide a clear view of the weld parameters and settings," he says.

"The Rebel is an industrial quality MIG, flux-cored, lift-TIG and stick welding machine that offers excellent performance, particularly with difficult-to-weld E6010 (cellulosic) electrodes. In fact, ESAB encourages side-by-side weld test comparisons and believes that the Rebel will provide a superior experience for welders at all skill levels," he adds.

The new machine has two operating modes, basic and advanced, to make welding easier for beginners on the one hand, while allowing those with more experience to fine tune the parameters on the other. Operators interact with the Rebel using a control that combines traditional weld parameter adjustments with the functionality of a smart phone – the 4.3-inch colour display uses the same thin-film transistor (TFT) LCD technology found in smart phones. No other welder combines this level of simplicity, performance and control.

The Rebel accepts 100 and 200 mm diameter wire spools, runs 0.6 to 1.0 mm wires and enables users to run on 120 V or 230 V primary power. The machine weighs 18 kg, measures 584×229×406 mm and features a five-handle roll cage and uni-body construction that integrates the front, back and top panels to provide superior durability for protecting internal components.

When connected to a 230 V supply, the unit provides a MIG output from 20 to 220 A, a stick output of 30 to 180 A and a TIG output of 5.0 to 240 A. Applications include auto repair and restoration, maintenance and repair, mechanical contracting, light construction, farm and agricultural use, training facilities, sheet metal and HVAC.

The unit comes ready-to-weld for MIG and TIG processes and ESAB includes a professional-grade MXL 200 MIG torch, electrode holder and return cable

Right: Combining simplicity, performance and control, the 4.3-inch colour display uses the same thin-film transistor (TFT) LCD technology found in smart phones.

Below: The unit comes with an MXL 200 MIG torch, electrode holder and return cable kits (3.0 m), a 4.5 m gas hose with a quick connection to the machine, a 200 mm spool of 0.8 mm Aristorod 12.50 wire, as well as contact tips and drive rolls for wires between 0.6 and 1.0 mm wire.

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"The Rebel EMP 215ic offers outstanding all-process arc performance because ESAB has enhanced the control algorithms from our industrial systems such as the Warrior™ and Aristo®, gathered input from real world welders and then incorporated that knowledge into the Rebel design," Brightwell says.

With the Rebel's smart MIG (sMIG) function, users begin MIG welding by setting metal thickness and selecting the wire diameter. The Rebel will automatically adapt to any popular steel, stainless, chrome-moly or aluminium filler metal/gas combination and provide a stable MIG arc. The sMIG mode enables users to weld thicker or thinner metal by increasing or decreasing wire feed speed, as well as to raise or flatten the bead profile (crown) by increasing or decreasing the voltage (trim). Welders can also adjust inductance to fine tune arc stability and control spatter. As users adjust one parameter, sMIG automatically adjusts others to keep the MIG arc stable.

Using an exclusive, built-in algorithm, sMIG monitors the operator's technique and continuously adapts the MIG output to provide a stable arc and superior, repeatable welds. The Rebel enables experienced welders to become more productive and novice welders to start producing quality welds in less time. "The sMIG feature takes away the doubt of welding with incorrect settings and so users can focus on good welding torch technique. The machine gives users confidence to weld anywhere with a ready-to-weld package," he adds.

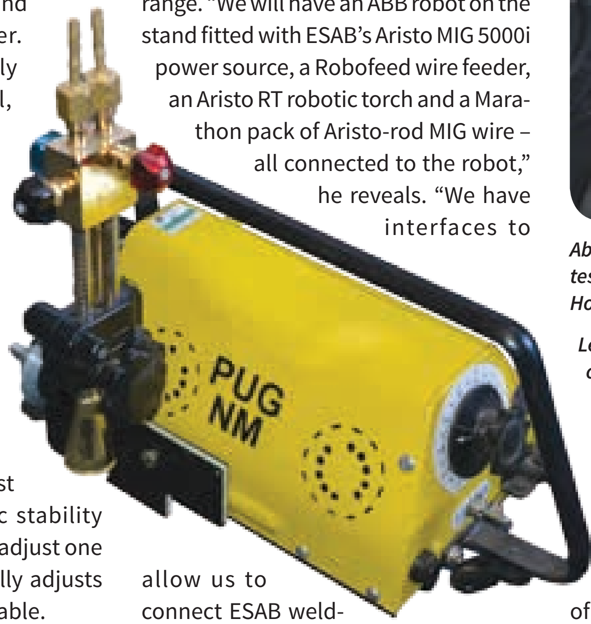
For those welders who prefer traditional MIG and flux-cored welding, the Rebel enables users to pre-set and adjust wire feed speed and voltage, as well as set run-in (creep start) speed, adjust burn-back control and program timers for spot and stitch welding. When welding, the control shifts to display amperage and voltage.

Because different types of MMA electrodes require different controls, the Rebel lets users optimise performance by selecting from one of two settings: Cellulosic Electrodes (E6010, E6011) or all other Electrodes (E70XX, E308, E309, E316). To further fine-tune performance, the Rebel features adjustable arc force and hot-start control.

With TIG as well as MIG welding, users can select either 2T/4T trigger control; 2T for standard operation and 4T to provide a hold function that reduces hand fatigue.

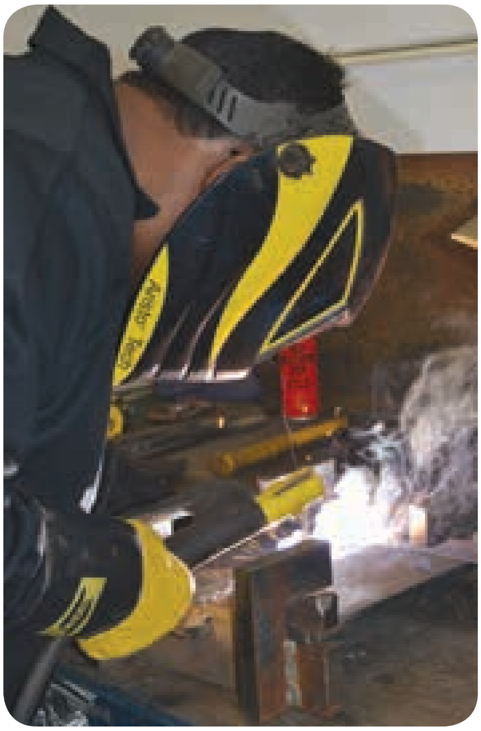
Other ESAB Innovations on show

Also on the machine side, says Brightwell, ESAB will be featuring its full-featured high-end Aristo equipment range. "We will have an ABB robot on the stand fitted with ESAB's Aristo MIG 5000i power source, a Robofeed wire feeder, an Aristo RT robotic torch and a Marathon pack of Aristo-rod MIG wire – all connected to the robot," he reveals. "We have interfaces to allow us to connect ESAB welding equipment to almost any robot brand, but because of the longstanding co-operation between ESAB and ABB, which both have Swedish connections, a lot of ABB robots are supplied with ESAB welding equipment," he tell *African Fusion*.



ESAB consumables continue to do well in southern Africa. "75% of our local sales are consumables, led by our OK AristoRod 12.50 advanced surface characteristics (ASC) solid wire, which undergoes a unique surface treatment process instead of being copper coated. This leads to excellent starting properties; trouble-free feeding at high wire speeds and lengthy feed distances; a very stable arc at high welding currents; extremely low levels of spatter; low fume emission; reduced contact tip wear and improved protection against corrosion of the wire," Brightwell explains.

ESAB SMAW electrodes, such as the XcelArc E6013 general purpose electrodes also do well, "but our OK range of low-hydrogen electrodes, such as the OK55.00 LH, are among the best in the world. These are fully tested to Sasol specs and are vacuum packed. Also, because the electrode contains some metal powder in the flux, the electrode delivers 125% weld metal recovery per kg of core wire – one of the highest efficiencies and a market differentiator for us," he adds.



Above: QA technician, Steven Soobramoney welding test plates for approvals at ESAB's new home with Howden Africa in Booysens.

Left: ESAB's Pug tractor is ideal for mechanising gas or plasma cutting.

Also to be featured are ESAB's new range of Victor gas equipment, regulators and cutting torches manufactured to high-end standards. Flash back arrestors and ESAB's Cut Master range of hand held plasma cutting machines will also feature.

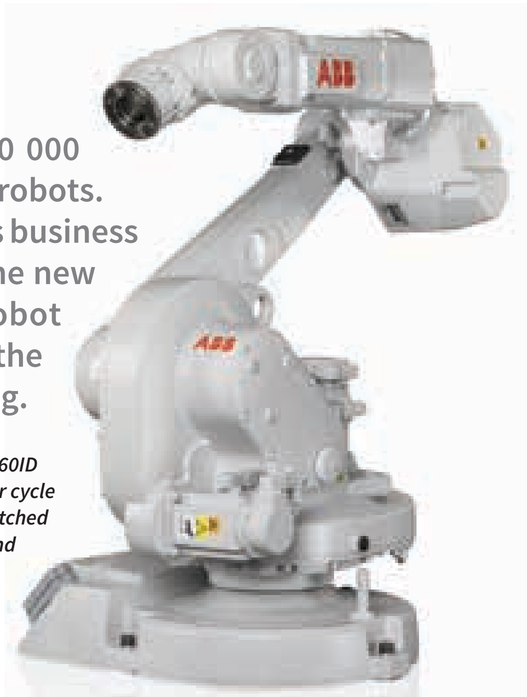
"The Cut Master range of compressed air-based plasma cutters goes from 40 to 120 A, but we can also supply systems with CNC cutting tables, such as the ESAB Crossbow, a small cost effective CNC cutting system," Brightwell informs *African Fusion*, before adding "We will also have our little Pug tractor on the stand, which is ideal for mechanising gas cutting.

"Following recent changes of our import and distribution partners in South Africa, we are settling down nicely in our new home with Howden Africa. We are starting to grow again and we see good opportunities, particularly in the construction and infrastructure development fields north of our borders," Brightwell concludes.


ESAB

New compact ID robot improves accessibility and precision

ABB, with an installed based of more than 250 000 robots, is a leading global supplier of industrial robots. *African Fusion* talks to ABB South Africa's robotics business unit manager, Ragnar Tonnessen (left), about the new IRB 1660ID, a high performance mid-range robot that allows cables and hoses to be routed inside the upper arm making it ideally suited to arc welding.



ABB's IRB 1660ID offers shorter cycle times, unmatched versatility and a smaller more powerful wrist.

Unveiled globally in June 2016, ABB Robotics' latest compact robot for arc welding and machine tending, the IRB 1660 Integrated DressPack (ID), is arguably the most versatile robot in the mid-sized class. This largely due to the new robot's hollow wrist, which makes it easier to program and simulate predictable cable movements.

"The hollow wrist allows the welding hose pack and cables to be housed in the protected space inside the upper arm. This enables better cable handling and easier torch access when space is restricted," Tonnessen explains, adding: "The shorter and more compact wrist also improves the robot's stiffness and end-point accuracy."

The new design is suitable for a variety of applications requiring fast, repeatable and highly accurate point-to-point or path following movements. ABB's 1660ID is ideal for customers requiring maximum productivity in high-robot-density arc welding applications or for machine tending applications in confined spaces.

Capable of carrying heavier welding torches – the payload is up from 4.0 kg to 6.0 kg compared to the IRB 1600ID – more powerful drive motors enable higher acceleration and deceleration rates. "These advantages, along with less need to slow down the robot arm to protect swinging external cables, result in shorter cycle times – reduced by up to 10% – and more predictable performance.

"The demand for superior and even quality in arc welding applications has increased, requiring improved wire feeding control near the arc to guarantee high volume production," explains Tonnessen. "The IRB 1660ID has a stronger more rigid upper arm able to lift up to 6.0 kg to accommodate heavier torches. This, combined with ABB's TrueMove™ technology and the new 'accuracy mode' provides 0.05 mm path repeatability (RT) for excellent welding results," he adds. In addition, position repeatability (RP) of 0.02 mm can be achieved and average TCP re-orientation accuracy is at 0.3 mm.

The IRB 1660ID with the aid of RobotStudio®, ABB's premier offline robot software programming tool, enables robot programmers to envision high density cells with several robots welding close to each other to reduce work piece heat distortion to a minimum. RobotStudio simulations help to secure safe robot movements with high speed and accelerations at all times to provide predictable and shortest possible welding paths and cycle times. "Such high-density cells can maximise output, provide quality parts and operate with unmatched reliability," Tonnessen advises, adding, "and slender profiles offer excellent access for welding inside narrow or internal spaces."

Welding is a key growth area for robot use, particularly among Tier 1 and 2 automotive components manufacturers.

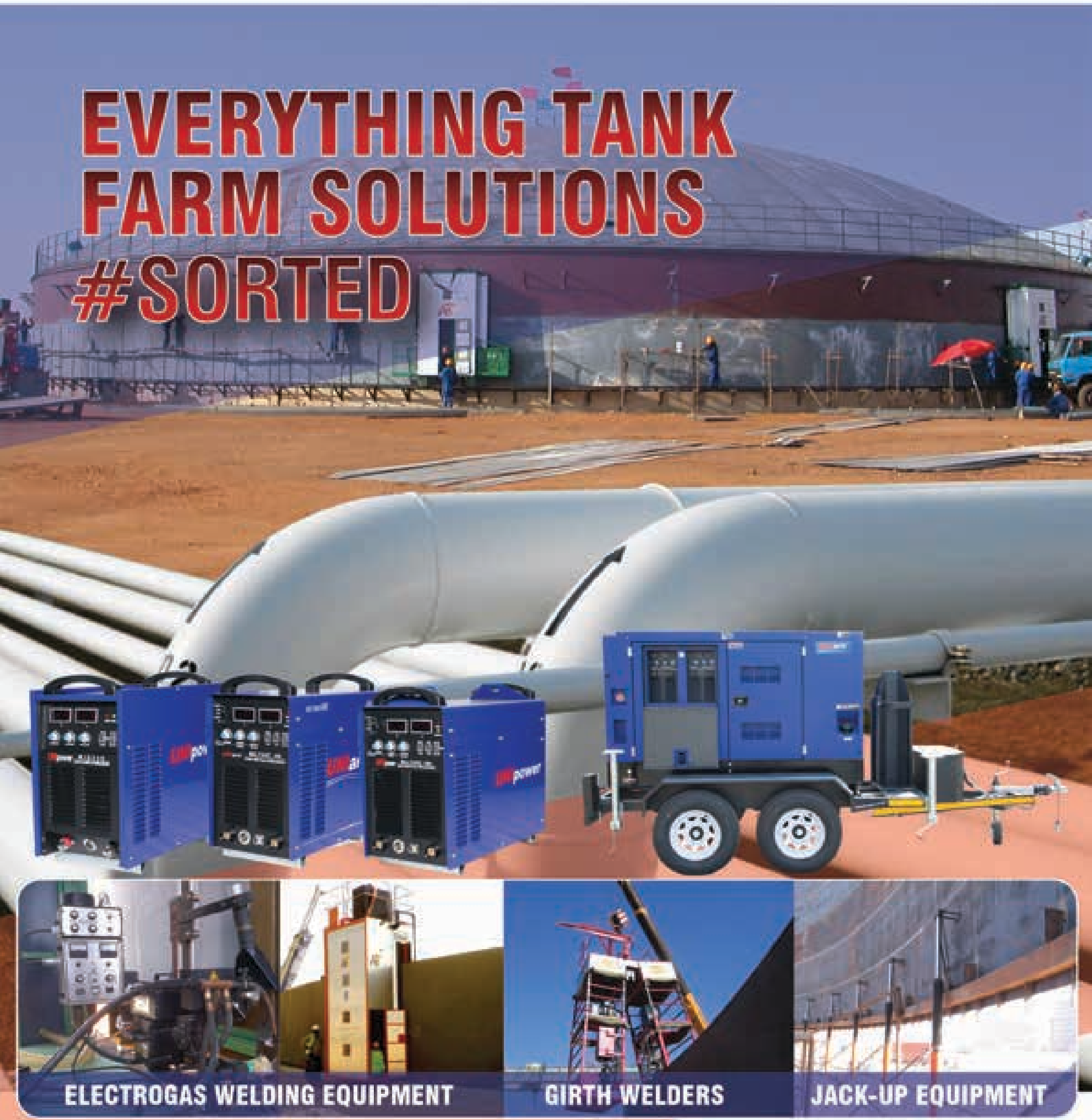
From a safety and reliability perspective, the compact and hollow wrist enables fast and reliable movements since the robot can move at maximum acceleration and speed without damaging the dress pack. The risk of collision in confined spaces is also reduced. The combined working range of axes 4, 5 and 6 is 1 390° which provides excellent agility and, for welding, the ability to complete 360° weld seams without having to stop for torch repositioning, thereby also reducing weld discontinuity risks.

"The robot wrist is IP67 ingress protected, which means that it is 100% protected against dust, electrical contact and water.

These advantages, combined with better movement control, amount to up to 50% lower maintenance costs and an associated longer equipment life.

According to Tonnessen, welding is a key growth area for robot use, particularly among Tier 1 and 2 automotive components manufacturers. "We also see robots being used increasingly for machine tending on assembly lines, offering up components for spot welding in stationary guns, for example.

"Although new robot installations in South Africa have been declining in recent years, we now see increased interest as more people become convinced that robotics and automation can be employed to significantly improve global competiveness and end-product quality," he concludes.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ELECTROGAS WELDING EQUIPMENT
GIRTH WELDERS
JACK-UP EQUIPMENT

Celebrating operational, safety and service excellence

Maropeng Bahula is a busy man. As general manager of technical services at Air Products South Africa, the scope of Bahula's job encompasses a range of elements critical to the success and sustainability of the company. These include all aspects of SHERQ management systems (safety, health, environment, risk & quality), as well as technical services and procurement.

"Whilst SHERQ management systems and a SHERQ focus gives a plant a license to operate, operational efficiency is equally as important as a plant ultimately contributes to operational profit. Therefore you need the skills to create business efficiency without compromising SHERQ," he says. "I have learnt that disruptions as a result of safety incidents are very costly to a business. This is largely due to the fact that incidents cause an interruption of production and there are a lot of additional costs related to investigation, repairs and other aspects related to the incident."

Since joining Air Products, Maropeng Bahula has embraced the annual Dexter Baker Awards, which aim to reward employees who have taken their responsibility to ensure the safety of themselves and others to heart, while delivering an outstanding service.

"We instil a mindset of continuous safety and quality in all our employees and our accolades are as a result of the commitment and dedication of individuals. We believe that we need to create a culture of safety and quality internally, which is sure to become visible externally to customers," says Bahula.

The Dexter Baker Awards and winners include:

- The Leonard Parker-Poole Safety Award: awarded to Kempton Park for the facility that achieved the best year-on-year EH&S improvement.
- The Chairman's Shield Safety Award: awarded to Cape Town for the facility that achieved the highest rating in their overall EH&S performance in the audits.
- Near Miss Award: awarded to Tshepo Mhlambi for recognising 'near misses'.
- External Customer Service Award: awarded to Port Elizabeth's Packaged Gases division.
- Internal Customer Service Award: awarded to Air Products' Marketing department.

Celebrating excellence is Maropeng Bahula (front, 3rd from right) with the winners at Air Products' Dexter Baker Awards function.

- The MD's Individual Award: two individuals were honoured: Beren Singh for his contribution towards ensuring a continuous CO_2 supply from the Newcastle facility; and Kevin Buick for his efforts in the management of the acetylene plant, which resulted in reduced costs and improved performance.
- The MD's Team Award: awarded to the team responsible for relocating the Head Office to Bryanston and refurbishing the Kempton Park offices; along with the Rustenburg optimisation team for their efforts to reduce energy consumption at the Rustenburg ASU and VSA facilities.
- The Dexter Baker team and individual Award: awarded to the JDE upgrade project team received for their dedication in the upgrade of the JDE 9.1 system, while the individual award was awarded to Dipesh Harkison for supporting key business projects whilst maintaining a high standard in his core job function.

Bahula concludes with the vision for the next year: "We are aligning ourselves to a global Air Products approach – to grow through sustainability-driven opportunities, reduce environmental footprints through cost-effective improvements and to care for employees, customers and communities."

www.airproductsafrica.co.za

SKS extends worldwide network of subsidiaries

Worldwide, the number of industrial robots is growing rapidly. Based on data from the IFR (International Federation of Robotics), around 240 000 units were sold in 2015. By 2018, 1.3-million industrial robots will be deployed worldwide.

Automotive companies and their suppliers are still the main purchasers of industrial robots. Their main area of application is welding. The resulting demand for planning, consulting and other services for automated, highly productive, highly reliable and highly available arc-welding technologies is where SKS Welding Systems comes in. To meet this demand, SKS is currently extending its global organisation.

Starting from 1 August 2016, customers and users in the USA, Mexico and the People›s Republic of China will be able to make use of the Kaiserslautern, Germany-based company›s technical expertise in their own countries. The three new subsidiaries double SKS's number to six.

In addition, SKS is represented by partners in 11 selected countries. In 2015, the direct export of automated welding systems from Kaiserslautern, accounted for over 60% of the company's total sales. SKS focuses on automated and, above all, robot-assisted welding. The company has developed and implemented fully digital welding systems for over 25 years.

SKS is committed to the high quality standards of the German industry, both at home and in the partner countries. "We see the equipment for automated welding as a holistic solution for our customers. Therefore, we accept overall responsibility as a full-range supplier," says Markus Klein, managing director. The company gained its experience and expertise in robot-assisted welding through its close cooperation with manufacturers of the automotive and supplier industries. This cooperation led, for example, to the development of welding processes such as microMIG and KF-pulse for the joining of thin metal sheets.

www.sks-welding.com

Renttech South Africa at Electra Mining

The 12th September heralds the start of Electra Mining 2016 and Renttech South Africa will be exhibiting as they have done for many years.

The company's managing director, Gerrit van Zyl (right) explains: "Electra Mining provides us with an excellent platform to showcase our company's full welding, power generation, lifting and rigging product ranges to our mining and manufacturing customers. It is also an important opportunity to engage with our valued client base, both from South Africa and the rest of the continent," he says.

Offering both sales and rental options, Renttech is an equipment supplier to the engineering, industrial, construction, petrochemical, power generation and a variety of other sectors across South Africa and sub-Saharan Africa. The company has the largest fleet of rental welding equipment in southern Africa, including: Harris, Lincoln and Renttech's own UniArc and MultiArc welding and metalworking product ranges.

When it comes to tools used in brazing, soldering, welding and cutting applications, welders the world over rely on the quality of equipment from the Harris Products Group. Equally synonymous with quality, Lincoln Electric is a global manufacturer with an extensive range of high-quality welding, cutting and joining products, arc welding equipment, welding consumables, plasma and oxy-fuel cutting equipment and robotic welding systems.

Renttech South Africa also has several of its own welding solutions, which "tick all the operational and energy efficiency boxes", according to Johan Bester, Renttech's welding product manager. "For example, the Multiarc 350 Compact multi-process inverter is a robust, lightweight unit that offers customers an easy transition between multiple welding processes, bringing new levels of versatility to the end-user, as well as cost-saving advantages," he explains.

"In addition, Renttech's UniArc Mag200 MC is a multi-process inverter which is especially versatile, offering not only gasless flux-core welding but also able to be used in MIG welding, stick welding and TIG welding," he adds.

Visitors to the Renttech stand will also be able to inspect the company's versatile twin-pack welder-generator – equipped with two 300 A/400 A welding units, a 30 kVA, three-phase 50 Hz power output and two 6.0 kVA/230 V power outlets – which can also be used for grinding, drilling and lighting. In addition, the twin-pack model has a single 30 kVA/380 V power outlet that meets OHSA specifications.

"We are going to have a strong team on the Renttech stand, where every staff member has high levels of product knowledge and experience. While stand space does not allow us to conduct demonstrations at the show this year, should anyone wish to see and experience our products in action, we will be delighted to arrange for a demonstration at their facilities," van Zyl advises.

www.renttechsa.co.za

Welding pipes faster using QuickPurge systems

Time is money and waiting for pipe joints to be purged for welding can take anything up to four hours, depending on the diameter of the pipe being welding and the method chosen for purging.

Huntingdon Fusion Techniques, HFT®'s innovative QuickPurge® System dramatically reduces waiting times, producing zero discolour welds and no loss of corrosion resistance caused by high temperature oxidation during welding.

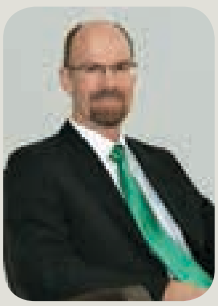
Ron Sewell, chairman for HFT says: "A 36-inch diameter stainless steel pipe, for example, can be purged down to 100 ppm of oxygen in under 32 minutes. Compare this with purging using foam dams that will outgas heavily into the weld zone and will take hours, not a few minutes," he says.

QuickPurge Systems are manufactured for pipe diameters from 150 to 2 440 mm and are equipped with a QuickFit coupling for the purge/inflation hose.

High speed pipe purging system QuickPurge® is leading the way in the field of purging tube, pipe and pipeline joints in over 6-inch diameter pipe, where oxygen levels are required to be as low as 10 ppm or less.

Using IntaCal® combined with

Robert Richardson appointed MD of Air Products South Africa



Air Products South Africa's Board of Directors has announced the appointment of Robert Richardson as the company's new managing director. Richardson succeeds Mike Hellyar who recently announced his retirement after nine years at the helm of the industrial gas company.

Richardson has an MSc degree in engineering, and over two decades of experience in the industrial gases industry. He has served on Air Products South Africa's executive management committee for the last eight years in the position of general manager On-Sites. Prior to this, he held various operations and project management positions within Air Products and also with the Linde Group.

Richardson is the 4th MD to be appointed in Air Products South Africa's 47-year history.

Effective component protection with PTA

"The Plasma Transferred Arc (PTA) welding and hardfacing process is a versatile, high temperature, wear- and impact-resistant welding process that guarantees a high quality weld deposit making it ideal for protection of components in severe impact, wear and corrosive environments," says Shaik Hoosain, metallurgical engineer for thermal spray specialist, Thermaspray.

First introduced to the welding industry in 1964 as a method to better control arc welding processes in lower current ranges, the PTA process provides a versatile method of depositing high quality metallurgically fused deposits on relatively low-cost substrates to protect components against severe corrosion or abrasion, thermal shock, slurry erosion or impact forces.

An extensive variety of materials, ranging from soft/medium hardness (e.g. stainless steel) to very hard, wear resistant materials (e.g. carbide composites), can be deposited using the PTA process to achieve diverse surface properties such as mechanical strength, wear, corrosion and creep resistance, delivering excellent reproducibility from batch to batch. Bead thicknesses range from 1.2 to 2.5 mm and multi-pass runs depend on the application.

Typical applications of the PTA process include pot roll journals (coated with cobalt-base alloys for high temperature wear and corrosion resistance); scraper blades (wear areas of scraper blades are PTA welded with cobalt-base alloy for high temperature wear resistance); scraper rings/gearbox components coated with cobalt-base alloys; and high temperature steam valve components (valve seats clad with cobalt-base alloy). "Components used in glass manufacturing are also PTA welded with a Ni-based alloy to provide impact and wear resistance at high temperatures," adds Hoosain.

Typical applications of the PTA process include pot roll scraper blades, which are PTA welded with cobalt-base alloys for high-temperature wear resistance.

Alongside PTA welding, Thermaspray also provides a comprehensive range of support coating finishing technologies including machining, grinding and burnishing from its state-of-the art facilities in Olifantsfontein, Johannesburg.

www.thermaspray.co.za

◄ the integrated PurgeGate® device makes it possible to safely inflate the dams with argon gas and for purging the space between the dams where the weld joint is located. It is almost impossible for the inflatable dams to burst as a result of undue pressure or accidental flow increase.

All systems are manufactured as standard with a hose for connecting a Weld Purge Monitor®, which can read oxygen levels down to 10 ppm.

Materials chosen for QuickPurge are such that they are resistant to the higher weld heat present and at the same time exhibiting lower outgassing rates to prevent weld contamination. For heat-treated chrome steel pipe joints, HFT manufactures the special HotPurge range for the higher and longer temperature exposure requirements.

QuickPurge Systems are manufactured for pipe diameters from 150 to 2 440 mm and are equipped with a QuickFit coupling for the purge/inflation hose. The coupling is fitted with O-ring for gas tight sealing and a stainless steel collet to hold the tube mechanically tight. The coupling is fitted with an anti-release circlip to prevent parts accidentally separating inside the pipe.

The sleeve between the dams on the QuickPurge Systems reduces the volume to be purged by two thirds, ensuring a really fast purge time. Sleeve lengths for each size have been carefully calculated so that the QuickPurge Systems can be pulled around 90º elbows for the purging of connecting joints.

www.huntingdonfusion.com.

Welding Alloys turns 50

"The Welding Alloys Group turns 50 this year – what a milestone! Ever since its creation in 1966 in Fowlmere, Cambridgeshire, UK by the late Jan J.K. Stekly, the Welding Alloys Group has continued to flourish. Starting out as a hardfacing wire manufacturer in the UK, the company has developed into a truly global company, with a reputation as the go-to provider for advanced welding consumables, automated equipment for wear protection, and engineered wear solutions," says company CEO, Dominic Stekly.

"The Welding Alloys Group is proud to remain a stable family owned company, staying true to its values, with a clear focus on innovation, customer focus and customisation. We understand the need to deliver exactly what industry requires," he adds.

The Group now has operations in 35 countries, with 1 200 staff and sells into more than 150 countries. "We offer the widest range of advanced cored wires and tubular electrodes, a state-of-the-art machine product range for automatic cladding and surfacing, and a network of 25 INTEGRA workshops that provide global wear protection services from wear plates to fabricated components; hardfacing and cladding to machining applications; welding and spraying, ceramic and plastic coating – all offered either in-situ or in the workshop," Stekly says.

Welding Alloys' current turnover is around £120-million, with a clear strategy to increase this to £200-million by the year 2020.

To mark the occasion of the 50th anniversary, the business and sales leaders of the Group celebrated the event in Spain. During this event, a charity drive was organised by the founder's grandchild, Abbie Hughes, to help a school in Lesotho and more than €17 000 was raised.

Welding Alloys' updated icon 'Sparky' was also unveiled during the celebrations.

www.weldingalloyssa.co.za

Welding Alloys Group has a network of 25 INTEGRA workshops that provide global wear protection services.

High speed robotic spot welding

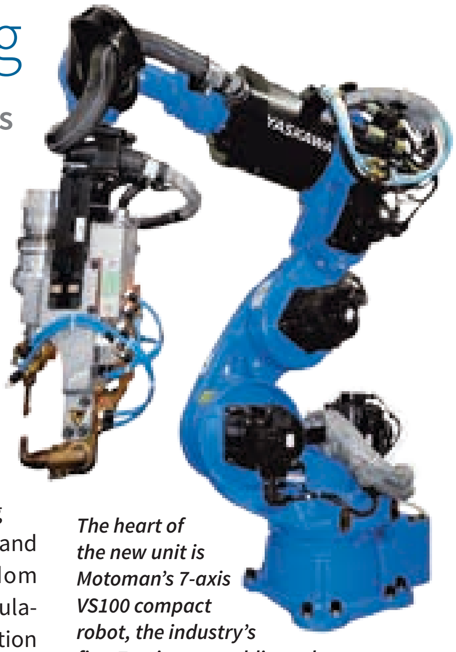
Yaskawa's Robot-based spot welding system with two 7-axis units: an all-in-one solution.

Yaskawa has developed a compact and flexible system for high-speed robot-based spot welding. The modular solution comprises a cell with a positioner and two spot welding robots, particularly lightweight spot welding guns, a nut welding machine and a full range of accessories.

A combination of high-performance components results in significantly faster cycle times in spot welding applications than with conventional solutions. At the same time, the design of the robot-positioning cell is so compact that it requires up to 40% less space than a comparable unit. A high degree of rebuilding flexibility from one product to the other makes for additional flexibility in production. The frontal 'robot-on-board' positioning of the manipulators allows simple removal of the component without interference contours.

Compact robots and spot welding guns

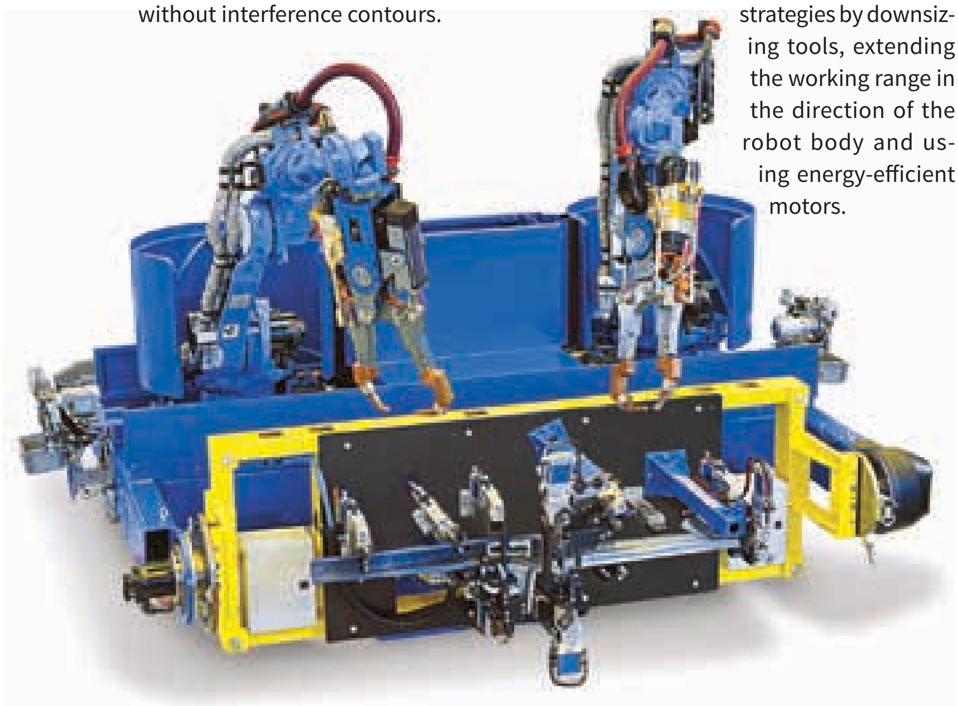
The heart of the unit is the 7-axis Motoman VS100 robot with a payload of up to 110 kg. The model has an additional tilting axis and offers a highly flexible working range. It can work close to workpieces and other robots, thus enabling flexible and space-saving system design. The additional axis and resulting added degree of freedom permits reorientation of the manipulator axes without changing the position of the spot welding gun. This enables the robot to reach deep into confined spaces or perform longer linear movements. The interference contour of the entire manipulator can be adapted by programming. This robot also contributes towards Yaskawa's improvement strategies by downsizing tools, extending the working range in the direction of the robot body and using energy-efficient motors.



The heart of the new unit is Motoman's 7-axis VS100 compact robot, the industry's first 7-axis spot welding robot.

The robots are supported by the new generation of spot welding guns, which are distinguished by their extremely light weight. They operate without a compressed air system and are of lightweight construction, making them an ideal complement to the compact robots. Energy consumption is accordingly lower. The deliberately simple design of the gun body, transformer and motor nevertheless guarantees a high degree of robustness. The lateral routing of cables improves the turning capacity of the robot hand and the standard version can be configured in many different ways.

A nut-welding machine that was also newly developed by Yaskawa rounds off the new range for robot-based welding processes. It consists of a welding construction that can be set in multiple positions and has an adjustable welding head. A Motoman MH5 handling robot automatically feeds the items to be welded, such as nuts, bushings and pins. This integration of all components in a standardised machine offers numerous advantages in terms of autonomy, performance, reliability, maintenance-friendliness and flexibility of the unit.



Yaskawa's high speed robot spot welding system comprises a cell with a positioner and two spot welding robots, particularly lightweight spot welding guns, a nut welding machine and a full range of accessories.

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