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Following the proven success of the VRTEX® virtual training solution, Lincoln Electric is launching its REALWELD® training system into South Africa, a monitoring and live coaching system designed to monitor skills during real welding. *African Fusion* talks to Benoit Lamotte and training school specialist, Louis Uys of Airtrax.

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March 2017

FEATURES

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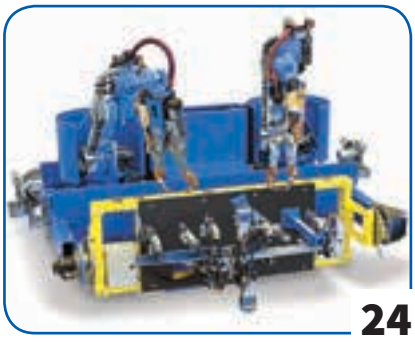

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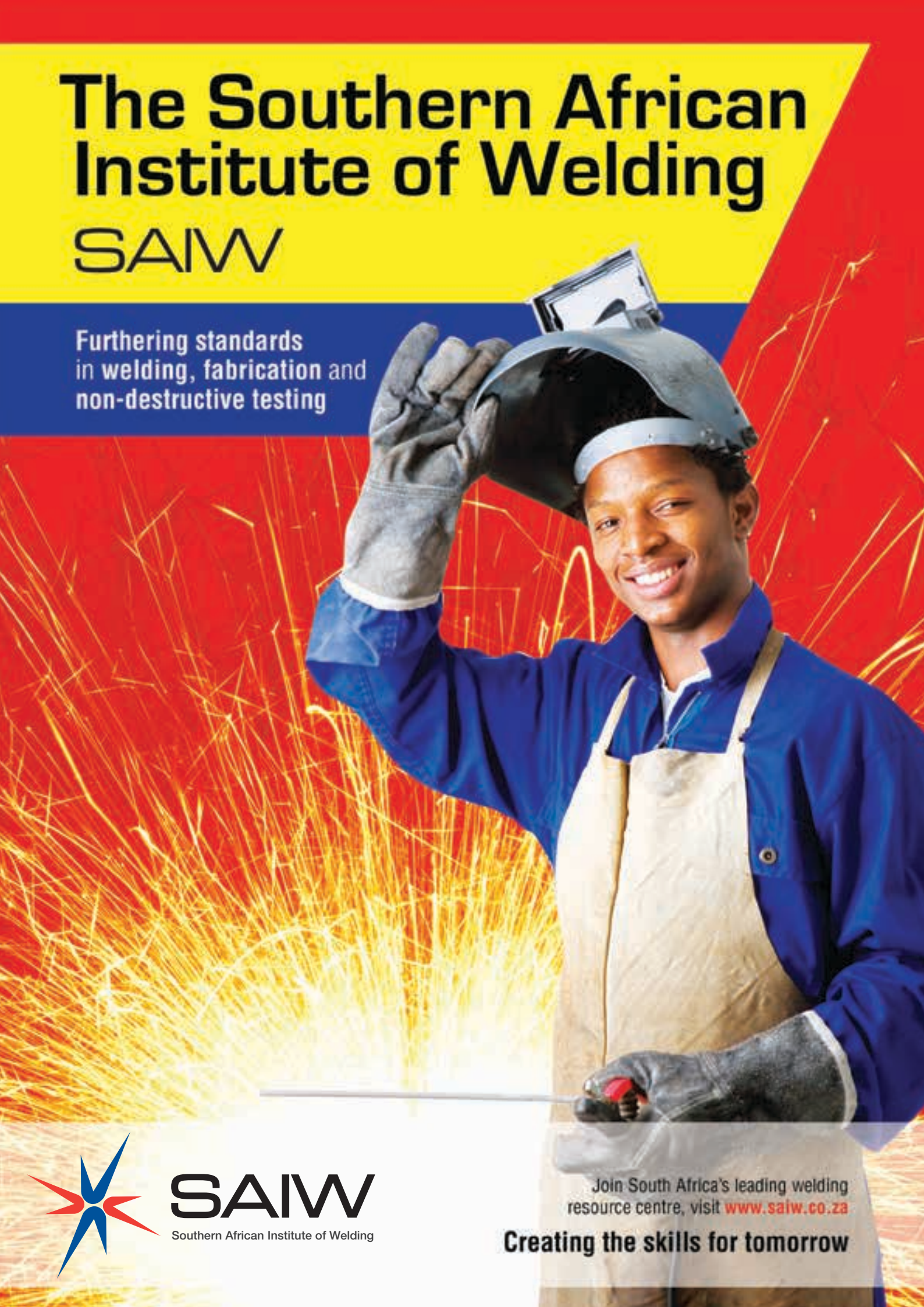

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Southern African Institute of Welding

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The WorldSkills SA competition was held in Durban last month and we are very pleased with the organisation of the event and the results. Philippus Terblanche, who won our SAIW Youth Welding Challenge last year, again emerged as the winner. Congratulations to him, but also to the other two candidates, Angel Mathebula, a product of the SAIW Foundation, and Samukelo Mbambani who, like Philippus, comes from ArcelorMittal's welder training school.

We also need to extend our gratitude to both Lincoln Electric and Afrox who aided and supported SAIW in providing equipment, consumables and valuable assistance to make the event the success it was from a welding industry perspective.

We are also particularly pleased with the support and importance now being placed on the competition by the Department of Higher Education and Training (DHET). Progress is being made to expand artisan skills and to improve the quality of artisan training and evaluation in South Africa.

The education department is now convinced that learners need start to become skilled at a younger age. This makes TVET colleges and technical high schools the best delivery channels.For this to succeed, close collaboration is required between industry and government. We need a strong focus on resourcing colleges with workshops and equipment so that appropriate quality practical training can take place. SAIW members have shown time and again – through both direct sponsorships and by giving of their time and experience – that they are willing to support skills development in the welding industry. The SAIW is keen to assist the department and individual TVET colleges to promote welding to our youth, which we believe is a miracle career.

The second group of six SAIW Foundation students has now started on the IIW International Welder programme at SAIW. In this regard, we are pleased to have secured industry cooperation, through ArcelorMittal, to support the training programme at the SAIW. In addition, the experiential training for these students will take place at ArcelorMittal sites.

We see this as a model programme for high-level welding skills development. All four of last years' students are now IIW International Welders. Most notably, Angel Mathebula, as well as being the star performer in the aluminium category at WorldSkills SA, has been employed by an SAIW member and placed on a fast-track career development programme. Another graduate, George Shongwe, has now joined the boiler maintenance programme and is doing remarkably well – welding with exceptionally low defect rates compared to norms. These two youngsters are proof of the effectiveness of the IIW International Welder programme.

The replacement course for SAIW Inspector Level 1 qualifications is now up and running and all future students will now receive the IIW Welding Inspector – Basic Level certificates. The IIW's International Welding Inspection Personnel (IWIP) suite of courses aligns with international standards and, by adopting them, qualifications awarded by SAIW will be valid around the world.

We continue to involve and support industry to raise standards by providing relevant value-adding services, through our certification schemes, training, technical support and testing and laboratory services. In addition, SAIW is striving to promote professional growth and social networking opportunities, through our evening meetings and golf days, for example.

We are also planning to hold an International Conference in 2018 and we are already seeking volunteers from industry, academia and government to be part of the organising committee. We look forward to hearing from people willing to assist.

Sean Blake

In conversation with SAIW's president

***African Fusion* talks to SAIW president Morris Maroga about his career, his outlook for the welding industry in South Africa and his ideas about a different approach to skills development.**

Morris Maroga completed his metallurgical engineering degree at Wits University back in 1999. "After completing my final year engineering project under Andy Koursaris, SAIW's former president, I remember him insisting that I stay for an extra two weeks – when I was desperate to get away from all of the study. I spent those weeks converting my final year project into a paper," Maroga recalls.

He joined Eskom directly from university and started looking at the creep life of in-service power stations. "After about a year, I was moved to Lethabo Power station near Vereeniging, where I began to get involved in systems engineering for steam boilers and high-pressure (HP) piping, branching from metallurgy into the mechanical side of engineering," he tells *African Fusion*.

"I have a broken service history at Eskom, though. After four and half years, I was approached by DCD Dorbyl to become its welding and quality engineer. At that time, I was just completing my welding MEng at Wits, which included welding, NDT and fabrication courses and, soon after, I was registered by the SAIW as an International Welding Engineer (IWE)," he adds.

Morris Maroga rejoined Eskom in 2005, initially looking after inspection and testing at the Koeberg nuclear power plant. Then in 2006, when the Medupi and Kusile contracts were awarded, he returned to Megawatt Park to take on the role of lead design engineer for the new-build boilers. "The designs were finalised during 2010, after which I was given the boiler engineering manager's post, which included oversight of all new-build and operational boiler plant," he says.

Today, Maroga is Eskom's corporate specialist for materials and welding – one of the most challenging technical posts in the organisation.

For all of the bad press Medupi and Kusile projects have endured, the SAIW president believes that the problems were mostly confined to the fabrication phase. "The design phase went relatively smoothly. We picked up some materials issues in Europe, through our membership of various international committees such as VGB PowerTech from Germany, which promotes collaboration about steam boilers and boiler operation. We are members and when issues concerning new super-critical boiler designs arose, we were able to revise our designs to overcome them," he explains.

In hindsight with respect to fabrication, however, Maroga does not believe South Africa was ready to take on two projects of this magnitude simultaneously: "We had not built a power station since the early 1990s. So nearly 20 years later, we found ourselves short of the right people, experience and skills.

"So many of the fabrication problems were not picked up early enough. Fabrications were already installed onsite by the time critical mistakes were detected. Several components had to be removed, which also required removing acceptable components in the way before re-fabricating and re-installing them in the reverse sequence. This obviously caused massive time delays," Maroga believes.

To date, although only one unit, Medupi Unit 6, is in full commercial operation, "of the 12 units across the two power stations, four more are now fully constructed and in commissioning," says Maroga. Medupi Unit 5 and Kusile 1 have been synchronised to the grid and are in the optimisation phase, while Medupi 4

The Kendal Power station (above) took an average of one year and 10 months to construct each unit. If all the units for both Medupi and Kusile are completed by 2022, the total construction time of 16 years puts the average time to construct each unit at one year and four months.

and Kusile 2 have been statutory pressure tested and are currently being commissioned. These could be synchronised later this year.

The remaining seven units are in different stages of development, but expectations are that the Medupi Units 3 and 2 and Kusile 3 will undergo pressure testing later this year. “So we are left with Unit 1 at Medupi and Units 4, 5 and 6 at Kusile that are going to take a few years yet,” he adds.

On the decision to build both of these large stations at the same time, Maroga says: “In retrospect, it may have been better to build them one at a time. The skills and capacity challenges we experienced on the fabrication side may well have been easier to handle had we been able to stagger the projects more effectively,” he responds.

The 11-year construction time for Kendal, from 1982 to1993, puts the average construction time per unit of the six-pack power station at one year and 10 months per unit. Currently the expected completion date is 2021 for Medupi and 2022 for Kusile, which equates to a total construction time of 16 years for all 12 of the new-build units. The average time to construct each unit is therefore one year and four months, still well ahead of the Kendal achievement.

Welding skills in South Africa

Maroga remains concerned about continuing welding skills shortages in South Africa. “With respect to training, we are all working in pockets, neither cooperating nor learning from one another. We use imported skills to complete projects, striving to get the project done as quickly as possible so that the imported welders can go home. We are not thinking about the bigger picture for the country.

“We never see new-build projects or shutdowns at our power stations and petrochemical plants as opportunities to develop new skills,” he says.

“When we import skills, usually at a premium cost, why can’t we create mixed teams of experts and locals with potential?” Maroga asks. “Then we can slowly increase the percentages of expert locals, who can, in turn, pass on their skills,” he urges.

“When I completed my matric, there were many apprenticeship programmes and training opportunities. But these have dried up. Assistance from training authorities is perceived as very hard to claim and more and more companies are under profit pressure. They do not want to spend money training a person that is going to leave as soon as they qualify. People are very mobile now and company loyalty is a thing of the past,” he notes.

“I review the IIW Certificates for the Institute and these are numbered. I was recently surprised when I noticed the certificates numbers in the mid-200s. Does that mean that since starting to offer IIW International Welder qualifications in South Africa, less than 300 people have been qualified? If so, we are not moving nearly fast enough,” he points out.

Maroga believes that the TVET college system is, fundamentally, well conceived but learners need to be in workshops rather than classrooms.

He believes that very few welder training schools in South Africa are training to international standards. “Many are ticking the boxes specified by localisation rules, but they are not genuinely trying to maximize skills levels in the country. There are even instances where a contractor will train welders but they still import welders to do the actual work that the local welders were being trained for,” Maroga notes.

But how are countries such as Thailand and Pakistan developing genuinely skilled welders? “They start them very young,” responds Maroga. “If our TVET system could be improved, that could help significantly.

“From Grade 10, it is often obvious which learners will succeed at our universities and academic colleges and which will not,” he explains. “Those that are more practically inclined should be encouraged to branch into a technical and practical career: welding, boiler making, plumbing or one of the electrical trades. If these learners start learning a trade when they are 15 or 16 years old, by the time they turn 20, they will already have completed four or five years of skills training. From there, they are much more likely to become masters of their trades,” Maroga argues.

He believes that the TVET college system is, fundamentally, well conceived. “But the reality is that few are actually developing practical skills. The ones I visit all have their learners in classrooms rather than workshops.

“Whenever we claim to be doing training, the focus must be on practical work with skills development as the core priority. It is the physical work that must be seen as the critical outcome of all training programme,” he advises.

Maroga sees collaboration as the key to overcoming our skills deficit. “I have seen final year university students being highly motivated by an industrial site visit. How much more would younger school-age learners be motivated?” he asks.

In terms of welding skills, he sees the IIW International Welder qualification as essential for raising the skills level of local welders. “At Eskom’s welding school in Midrand, for example, all welders are trained to the IIW level. Only after becoming qualified as an IIW International Welder do we send our candidates to national trade testing facilities such as Olifantsfontein in Gauteng and Majuba in KwaZulu Natal to write their South African trade tests. Following one-week’s preparation, our International Welders have a 100% pass rate on the local trade test. We at Eskom have now qualified 136 welders to this level and most have left with six IIW qualifications, TIG and MMA for each of three weld positions: fillet plate and pipe welding as well as the South African trade test qualification.

SAIW, he says, needs to have an umbrella role to get more and more training facilities, including TVET colleges, to use and qualify welders to the IIW International Welder standards. “As the authorised national body (ANB) for the IIW, SAIW, together with local industry, must get involved in working with TVET colleges to raise their standards. Practical training to the IIW standard will enable colleges to deliver the higher-level skills.

“And once a training school becomes an authorised IIW welder training centre, it must really qualify students to the International Welder level. It mustn’t simply use the authorisation as a marketing tool,” Maroga concludes.

Next generation inspectors qualify

At SAIW's first presentation dinner for 2017, 132 diplomas were awarded to successful students on SAIW Welding Inspection and IIW Welding Specialist (IWS) and Technologist (IWT) courses. *African Fusion* reports.

Herman Potgieter and Gert Joubert catch up at SAIW's dinner for the presentation of diplomas.

The OR Tambo Premier Hotel was the venue for SAIW's first 2017 dinner for the presentation of diplomas to students on SAIW courses, the most successful of these being Welding Inspection courses.

At the event: 69 SAIW Level 1 Inspection diplomas were awarded, five with distinction. 57 SAIW Level 2 Inspectors qualified, with six students achieving distinctions and 13 also receiving the IIW Standard Level Inspection certificate, which transforms the qualification into a globally accepted one.

In addition, Duran Naidoo qualified as a Welding Specialist (IWT); Nndwakhulu Mufamadi and Pasklys Nhlapo as Welding Specialists (IWSs) and Michael Amir was awarded the IIW International Comprehensive Welding Inspector Certificate, a Level 3 qualification.

A motivational address was delivered by Gert Joubert of ArcelorMittal, a passionate stalwart of inspection and of the welding industry in South Africa and chairperson of SAIW Certification's Governing board.

"Tell me and I forget, teach me and I remember, involve me and I learn," Joubert begins, quoting Benjamin Franklin.

"We gain knowledge to improve ourselves. A common denominator in this group is that all of you have gained knowledge – you passed the exams. A group of you has gained knowledge but you do not yet have the experience. You may have come straight from school or from another profession and you need some experience in the fabrication industry. Some of you came with some knowledge and lots and lots of experience. You know the industry and are taking things to the next level. And in between, there are those of you with some knowledge and some experience, not new to the industry but not yet where you want to be.

"Knowledge plus experience equals a qualification," Joubert points out, "and "knowledge plus experience plus skills results in understanding and the ability to do. It enables one to think things through and come up with practical solutions that work," he tells graduates.

But also, Joubert points to another less tangible measure for practical success: "What is the knack?" he asks. "I can explain what it is using a story. It comes from a factory making rifles during the war. In this factory there was a group of responsible for inserting the breech and locking it into place.

"There was one old guy who could do this without thinking, in seconds, but nobody else could. It always got stuck.

"They went to him and said: teach us how you do that. But he didn't know how he was doing it so he couldn't teach them. So one of the other worker sat

Above: Mhlungisi Kenneth Zulu and Anele Cecilia Sontaba display their new qualifications. Zulu received SAIW Level 2 and IIW Standard Level inspector certificates while Sontaba is now a Level 1 Welding Inspector.
Left: Michael Amir receives his IIW Comprehensive Level Inspector certificate from SAIW president Morris Maroga.

down and watched what he did, very carefully. Do it again, he kept saying, until the old man was getting irritated. Eventually the younger man noticed something.

"At a certain point of inserting the breech, he always tapped the assembly, which was just enough to get it past the sticking point so it could slide in the rest of the way. He had the knack," Joubert relates.

"You all now have knowledge. Some of you also have experience and skills, but all of you need to watch carefully and learn so that you can also have 'the knack' for what you do," he suggests.

Joubert says that, whenever welding and inspection is being done, there are always better ways of getting it right: "But some tricks can't be easily taught," he says, before relating a personal experience of when he was a young welding technologist.

"Herman Potgieter and I were on the shop floor at Vanderbijlpark, where we were busy fabricating a 62 t casting that required about 1.2 t of weld metal to be laid down.

"There was this one welder with years' of experience welding away. But we knew a little about setting up a CO_2 welding machine and, from the sound, we knew the setting was not right. But this old man was 'the expert' and we were too young to mess with the 'experts'.

"Oom, I said, can I adjust your machine just a little. No! he says. But I persisted and I persuaded him to give me one chance. I set a little more voltage and a little less wire speed and the machine went into a very smooth spray transfer mode with very little spatter.

"The old man carried on welding for a bit, then he stopped, lifted his helmet glared at me and said: Where have you been for the past 10 years. I have been welding with spatter and sparks and you come in and, in two minutes, you take away all of these problems. It's unfair.

"That is what you need to do. You need to look for opportunities to change the way the work is being done, to improve the conditions and the quality. Some 'experienced' people might resist, but even they might learn something – and with the knack and some insight you will be able to persuade them.

"I hope that SAIW courses have given you underpinning knowledge and insight into the world of welding and inspecting welded structures. You have the standards, you know the guidelines and the acceptance criteria.

"But take it to a higher plane, don't just rely on the knowledge you have now. Open up, stay humble, do you job well and coach people as often as you can," Joubert advises, before ending his talk with a toast: "To our loved ones: thank you for your support."

Nozipho Maphangela receives her Level 1 Welding Inspector Certificate.

WorldSkills SA and the new approach to artisan training

***African Fusion* talks to SAIW's Etienne Nell about the WorldSkills SA Welding competition and the breakthrough progress being made in South Africa with respect to artisan training and trade tests.**

Follow their success in the SAIW Youth Welding Challenge in November last year, Philippus Terblanche, Samukelo Mbambani and Nonhlanhla Angel Mathebula have again been demonstrating their welding skills, this time at the WorldSkills SA competition held at the Durban ICC from February 14 to 16, 2017.

Terblanche again emerged as the winner, which makes him South Africa's candidate for the WorldSkills International Competition in Abu Dhabi in October this year. Terblanche is a product of ArcelorMittal's training school in Vanderbijlpark, which uses a programme based on the IIW International Welder (IW) curriculum. "SAIW trained Peet Lottering, ArcelorMittal's welder training manager, and we are assisting the school towards becoming an SAIW Authorised Training Body (ATB)," says Nell.

Angel Mathebula won the aluminium category and took second place overall for welding at WorldSkills SA. Mathebula is one of the immediate successes of the SAIW Foundation. She has since been employed by Afrox and put onto a sponsored career development programme.

Mbambani, who finished second in the SAIW Youth Challenge last year and third at WorldSkills SA, is also a product of ArcelorMittal's welder training school.

Philippus will be going to Abu Dhabi. He will now undergo an intensive six-month training programme specifically for the competition.

"He will remain at the ArcelorMittal training school, but he will be focusing on WorldSkills-type welding projects that I will be assessing every week," Nell tells *African Fusion*.

"He will also come up to JHB for a one month intensive aluminium programme under the supervision of Aluminium Federation of South Africa's (AFSA's) welding consultant, Eduan Terblanche," he adds.

WorldsSkills SA was established about two or three years ago, originally as one of Merseta's portfolios. "But it has now been taken over by the Department of Higher Education and Training (DHET), under the watchful eye of Deputy Minister Mduduzi Manana," says Nell.

Our chances in Abu Dhabi? "There was a huge improvement in the standards being achieved at the WorldSkills SA competition this year, because the candidates received appropriate training in advance of the competition. Following the SAIW Welding Challenge, the training supervisors met to discuss the shortcomings and to establish a training programme to address them. As a result, I would say there was a 60% improvement in the point scores between last year's SAIW Welding Challenge and the February WorldSkills SA event," Nell notes.

With the additional training planned for Terblanche in preparation for WorldSkills International, Nell is "very confident that he will return from Abu Dhabi with a medal of excellence".

"I would like to thank all of our supporters and sponsors for the SAIW Youth and Senior Welding Challenges that led up to this event. And for WorldSkills SA, special thanks go to Lincoln Electric for sponsoring the welding bay equipment and the consumables. They came to the party 100%, giving us everything we needed to run the competition successfully," says Nell.

Judges evaluate carbon steel pressure vessel projects at a WorldSkills International competition.

A new vehicle for artisan training

As well as lending his personal support for WorldSkills, Deputy Minister Manana is championing an expanded role for the TVET colleges, which he sees as the best vehicle for artisan development and trade testing.

"This vision is embedded in the work of the National Artisan Moderation Body (NAMB) and the trade tests will now be changed to meet the requirements of the new Curriculum Quality Council for Trades and Occupations (QCTO)," Nell explains.

For welding, the QCTO is a new curriculum that attempts to raise artisan welder skills to international levels. The curriculum has adopted the essence of the IIW training standards, largely because of the influence of SAIW's Etienne Nell. "I would say that the new QCTO welding curriculum overlaps with the IIW International Welder programme by about 70%," he reveals.

Taking International standards on board, "the QCTO curriculum now meets the Bratislava International agreement, which urges all countries to adopt common global standards when it comes to welding trades. About 50 countries across the world have now adopted these standards for the qualification of welders," Nell tells *African Fusion*.

"So if a South African welder passes the new QCTO-based trade test, he or she can secure a job anywhere in the world. That is what is so excellent about this new curriculum. We have been working towards this for years and it is now being pushed at the highest levels for use in the TVET colleges," he adds.

TVET Colleges as ATBs

SAIW and Nell are also in discussions to change the TVET colleges further. "We would like TVET colleges offering welding courses to consider becoming SAIW Authorised Training Bodies (ATBs) for the IIW International Welder Programme. IIW Welder training is equivalent to the QCTO curriculum, so colleges can kill two birds with one stone. When artisans leave a TVET ATB college having passed their trade test, they can also receive the IIW International Welder (IW) qualification," he suggests.

"I strongly believe that ATBs, together with the TVET colleges, when accredited by SAIW to do IIW welder training and following the QCTO curriculum for the trade tests could be the answer to our skills problems in welding.

"With the DHET now driving this process, we may be able to stop importing welding skills. Instead, we will end up with South African welders with international qualifications and the skills to get work all over the world," Nell concludes.

Lincoln Electric has been sponsoring WorldSkills International for the past four years and has come onboard to sponsor the local WorldSkills SA competition.

HC Heat Exchangers exceeds challenging

Based on an assessment carried out on December 1, 2016, HC Heat Exchangers' workshop in Elandsfontein, Gauteng, was certified under the IIW Manufacturer Certification Scheme for the management of quality in welding in accordance with ISO 3834 Part 2 – Comprehensive Quality Requirements. *African Fusion* talks to Hans Banza, the company's responsible welding coordinator.

HC Heat-Exchangers (HCHE) is a design and manufacturing company specialising in the manufacture of heating, ventilation, air conditioning and refrigeration equipment. Started in the 1970s as the Heating Centre group, the company traded under the German Günter SA banner from 1995 until Günter's withdrawal from South Africa in 2001, after which HC Heat-Exchangers was established as an entirely South African-owned company.

Today, HCHE is the largest manufacturer of finned-tube heat exchangers in southern Africa, serving both the commercial and industrial market segments. The equipment range produced comprises commercial refrigeration products through to large custom-built units for industrial applications.

"We produce condensers, evaporators – both flooded and direct expansion –chilled water coils, hot water coils, steam coils and dry coolers. We offer a variety of different construction materials to suit all operating environments including all-stainless coils designed and manufactured to SANS 347 and ASME B31-5 specifications and welded according to ISO 3834 Part 2 quality requirements," Banza tells *African Fusion*.

From an original 2 500 m^2 facility, HCHE has rapidly expanded and is already looking to expand on its 16 000 m^2 production facility in Elandsfontein, east of Johannesburg.

"We moved into these premises at the start of 2015 with almost 300 people. We are now nearing 350 and are looking for additional space next door. We have added a new HVAC division to our facility in order to handle specialised products such as rooftop air-handling units and we have recently launched a product called the Dew Maker, which extracts drinking water from the air. We design all of our products with sustainability in mind," Banza says.

Hans Banza (third from left) receives a Sassda Columbus Stainless award on behalf of HC Heat Exchangers: from left: Charles Cammell, chairman of Sassda; Shannon Freeman, Jaguar Stainless Steel; Hans Banza, HC Heat Exchangers; and John Tarboton, executive director of Sassda.

One of the biggest stainless steel products HCHE has manufactured thus far, an 890 kW spiral freezer manufactured by the compan to freeze poultry products.

HC-branded systems are used by supermarkets such Checkers Hyperama, Shoprite, Pick n' Pay and Spar. Other project successes include the Mall of Africa, Logico Swaziland, Bluff Meat Supply and Aramex.

"We continue to produce products customised from a standard platform to ensure consistency in the quality of the delivered product. With our expansive industry knowledge and a clear understanding of our customers' applications, we deliver products tailored to their exact requirements – always striving towards an optimised solution," he adds.

Success at the Stainless Awards

HC Heat Exchangers was a joint runner up in two categories of the Sassda Columbus Stainless Awards in 2016: the Food and Beverage category and the Engineering category.

The Food and Beverage accolade was awarded for one of the biggest stainless steel products HCHE has manufactured thus far, an 890 kW spiral freezer manufactured by the company to freeze poultry products. The unit, constructed almost entirely from 304 stainless steel, with only the fins and fan panels being made from aluminium, is designed to freeze over 10 t of poultry per hour. Cold air leaves the heat exchanger at -34° C and is blown into a 10 m high cylindrical room, which contains the conveyer carrying the poultry. As the product passes through the system it is quickly frozen and packaged.

One of the key challenges faced in

requirements

Above: The welding of HCHE's heat exchangers involves significant amounts of stainless steel: 304 and 430 grades on tubes, pipe and plate.

Right: TIG welder training taking place at HCHE's Elandsfontein premises. "Almost all of our welders are qualified for tube welding using TIG," says Banza.

the construction of this unit was the sheer size of the fully assembled unit. At over 12 t in weight and measuring 8.0 m long by 3.0 m high, it was far larger than anything HC Heat Exchangers had previously attempted to build. This problem was overcome by adopting a modular design and construction approach.

The Engineering runner up award was for the development and manufacture of a full stainless steel tubed heat exchanger providing 800 kW of cooling and dehumidification as well as 20 kW of reheating. The heat exchanger is used in a gas cooling application to provide cool combustible gas to a generator engine for the purpose of power generation.

Welding and ISO 3834 certification

"We need to work to international standards so that customers can be confident that our products are safe, reliable and durable. In our products, there is not a great deal of welding compared to some fabrications, but the welding that we do is critical because the equipment is classified as a pressure vessel and none of the tubes can leak. The quality of our heat exchangers cannot be guaranteed unless the welds are all 100% sound," Banza argues.

"ISO 3834 is particularly important on the big industrial units for petrochemical clients, for example, where welding quality is even more critical," he says, adding "and our sales engineers are telling us that certification definitely gives us a competitive advantage on tenders, particularly on export contracts and when competing with overseas-based companies."

As the responsible welding coordinator for HC Heat Exchangers, Banza takes care of all aspects of the welding quality requirements for the ISO 3834 certification. "We have twenty qualified welders now working according to ISO 3834. They like the system. There is a little more work, because we need to adhere to the welding procedure specifications and the paper work needs to be kept in order for record keeping and traceability.

"But it changes the role of welder too. Instead of just manual welding, they now need to get more deeply involved: reading the welding symbols on technical drawings, for example, and learning how best to avoid distortion. Some higher level training is now involved, which keeps the work interesting and more motivating," Banza suggests.

"Training happens mostly through the SAIW, but we also do training in-house. We then send weld approval samples on to the laboratories for testing," he adds.

"The welding of our heat exchangers involves significant amounts of stainless steel: 304 and 430 grades on tubes, pipe and plate. Tubes from 11 to 16 mm in diameter are commonly welded, with wall thicknesses in the region of 1.0 mm. Pipes, which typically range in diameter from ½-inch to 6-inches, generally have heavier wall thicknesses, up to 8.0 mm," he informs *African Fusion*.

The dominant processes used are TIG or GTAW welding. "Almost all of our welders are qualified for tube welding using TIG. We use IsoArc WSE ac/dc welding machines from Thuthuka Welding, because we also do aluminium welding so we need to be able to switch over to ac," Banza tells *African Fusion*.

On the structural side, HCHE also fabricates containment systems for its units, which have carbon steel frame structures that are welded using the GMAW process.

From an inspection point of view, "every unit goes through a submerged pressure test so that leaks can be picked up and immediately rectified," Banza continues. "And for open ended tanks where pressure testing is impossible, we use dye penetrant testing (PT) to highlight any surface flaws.

"Some customers might also ask for radiography to be done on completed welds, in which case we contract a third party inspection company to come in to complete the inspection, usually overnight. Our petrochemical clients occasionally request this service. Any rework is usually handled between me and the welding manager and issues are very quickly resolved," he assures.

"Training in every aspect of our work is critical to achieving good quality levels," Banza concludes. "Our HR department likes everyone in the organisation to be involved in ongoing development so that everyone knows more and more about what they are doing," he concludes.

Advanced training solutions:

Following the proven success of the VRTEX® virtual training solution, Lincoln Electric is launching its REALWELD® training system into South Africa, a monitoring and live coaching system designed to monitor skills during real welding. *African Fusion* talks to Benoit Lamotte of Lincoln Electric and training school specialist, Louis Uys of Airtrax.

The Lincoln Electric Welding School in Cleveland, Ohio is the longest operating and most comprehensive welding training facility in the world. The school was initially set up in 1917 and has trained more than 150 000 people in various welding technologies, techniques and associated safety practices.

"At Lincoln Electric we understand the importance of training. We have established and equipped hundreds of training schools around the world and we are a global industry partner of competitions such as WorldSkills International," says Lamotte.

Lincoln Electric has been the exclusive provider of equipment, consumables and fume extraction for the WorldSkills competitions for the past five years. "World Skills South Africa was held in February this year in Durban to identify South Africa's best young welder to compete in the 2017 World Skills International competition in Abu Dhabi later this year. Lincoln Electric was the official sponsor for the welding skill catagory, as it will be in Abu Dhabi," Lamotte tells *African Fusion*.

"No company in the world has more experience in setting up supporting welding schools than Lincoln Electric," continues Uys. His company, Airtrax, designs training schools; installing the safety infrastructure such as fume extraction and deciding which processes and machines will give young welders the best chance of success.

Uys believes that welder training should start in a classroom. "We believe it is best to start off on a welding simulator. Our studies prove that if a trainee starts learning about welding in our simulated environment, the chances of becoming a certified welder are much higher and faster."

Citing a trial conducted at the Iowa State University in the US, Lamotte says that a group of 22 trainee welders was split into two. One group began their training the traditional way, with a welding torch in hand and an instructor teaching them how to manipulate a real arc.

The other group started to learn using Lincoln's VRTEX virtual welding solution. Only once torch manipulation skills had been mastered, were trainees allowed into the workshop to start real welding. These 11 trainees spent 50% of the training time on the simulator with the other 50% being used in the welding shop.

"The pass rate with respect to the weld qualification tests was significantly better in group that spent 50% of their time on the VRTEX simulator," Lamotte reveals, adding: "although these people did less real welding, they were better welders at the end of the day." The VRTEX group proved 41.6% more successful in achieving certification, in spite of a 23% decrease in the overall training time.

Lincoln's VRTEX virtual reality welding system is a computer-based training system designed to supplement and enhance traditional welder training. These systems allow students to practise their welding technique in a simulated and immersive environment, promoting the efficient transfer of quality welding skills and body positioning to the welding booth while reducing material waste associated with traditional training.

The combination of a realistic weld pool and welding sound, and real-time feedback with respect to the position, speed and manipulation of the welding torch provide a realistic, exciting and hands-on training experience.

"There are now three different versions of the VRTEX system," says Uys.

At the starting point of introducing a student to welding is the VRTEX Engage™, which is a suitcase version of the system. VRTEX Engage includes a touch screen monitor, welding gun, tracking device and a work surface, all contained in a lightweight and portable carrying case that can be taken to classrooms, careers fairs or recruitment offices anywhere.

This is a cost-effective tool designed to expose or introduce students to welding, without the need for a workshop, welding machines, metal and con-

from virtual to real welding

Above: The VRTEX® 360 is Lincoln Electric's most advanced simulation trainer. Right: Lincoln's REALWELD® Advanced Trainer engages students in real welding, but it includes all of the coaching features associated with VRTEX simulation. Left: Used with advanced welding equipment such as the Power Wave® C300, REALWELD exposes students to the advanced manufacturing technologies used in today's industry.

sumables. The system includes introductory welding lessons, including safety, machine and process selection, welding procedure set up, welding theory and more.

A version one up from Engage is VRTEX Mobile™, designed to provide mobility in an easy to use and engaging welding training tool. The VRTEX Mobile is ideal for initial, basic welding training, as a recruitment tool for education and industry, for employment and screening for human resources, or as an evaluation tool for instructors and educators to get a baseline on student skills.

The VRTEX 360 is Lincoln Electric's most advanced welding simulation trainer. With an innovative full-scale welding table, student can practice in all positions. Coupons are available for a great number of welding joints, including pipe and pipe on plate.

In addition, through the Extensions™ Upgrade Program, the VRTEX 360 can grow with the training programme. The system has a bend test capability, carbon steel, stainless steel and aluminium weld simulation routines, Demo Mode to show optimal welding technique and Replay Mode to play back the trainees' weld performance from any angle.

"People think the systems are expensive," continues Lamotte, " but training itself is expensive and these machines are very cost-effective when used to complement a high quality training programme. While saving time and consumables, they give welding students live and continuous feedback about where they go wrong, which accelerates skills development and success rates significantly," he explains.

REALWELD: The next step

By adding a REALWELD® Advanced Trainer to a welding programme, training speed and results can be accelerated even further. "This system involves real arcs and real welding, but it includes all of the coaching features associated with VRTEX simulation. It takes the student out of the classroom, but maintains continuity with the skills development approach completed in the virtual world," Uys explains.

Used with advanced welding equipment such as the Power Wave® C300, REALWELD exposes students to the advanced manufacturing technologies used in today's industry. This is accompanied by audio coaching, instructor reviews and objective scores based on five welding parameters: weld speed, torch angles, aim, contact tip to workpiece distance/arc length and the position in the weld seam. Audio cues can also be turned off at any time, allowing the student or prospective employee to demonstrate learned behaviours.

"REALWELD is ideal for the student starting to learn how to weld and we see its main function as a training tool. But it can also be used it to validate the skills of experienced welders based on specific welding procedures or approvals," Uys adds.

As well as the GMAW (MIG) process, SMAW (stick) and FCAW processes can be accommodated. The system has a multi-pass monitoring capability for fillet, flat and vertical positions and pipe and pipe to flange welding can also be accommodated.

"REALWELD uses motion sensors, not cameras. This means that ideal manipulation and weld path parameters are constantly being analysed, which is far more useful than simply recording video footage of the welding.

"With the REALWELD system, feedback is immediate and accurate, which will obviously speed up the skills development process," Uys argues.

"This revolutionary training approach allows each student in the modern training centre to have their own personal live coach in a training cubical with fume extraction, a real welding machine and real welding conditions and positions," Uys tells *African Fusion*, adding that the trainer's role is changed to recording, analysing the results and identifying next steps in the programme.

As part of its commitment to improve welding training standards in South Africa, Lincoln Electric will be hosting a training seminar at its Weld Technology Centre in Midrand during May this year.

"Training standards in South Africa can be improved. The combination of VRTEX and REALWELD offers an alternative approach that is already proving highly effective in the US," concludes Lamotte.

Extending the life of welded components through UP

In this paper, presented at the IIW 2016 Conference in Melbourne, Australia last year, Jacob Kleiman and Yuri Kudryavtsev of Canada-based Structural Integrity Technologies (Sintec), present work about the use of ultrasonic impact treatment (UIT), also known as ultrasonic peening (UP), to prevent fatigue crack initiation and extend the service life of welded products.

The formation and propagation of cracks in welded structures plays a critically important role in the total life cycle of welded components. Ultrasonic Impact Treatment (UIT), also known Ultrasonic Peening (UP), was used in the rehabilitation and repair of welded elements with the goal of preventing possible fatigue crack initiation in existing welded elements and structures that are in service.

A number of large-scale welded specimens containing no-load carrying longitudinal attachments designed for fatigue testing were tested in the as-welded condition and after weld repair with and without the application of UP.

The testing conditions were zero-to-tension stress cycles (R=0) with different levels of maximum stresses. The fatigue testing was stopped and the number of cycles was recorded when the length of fatigue crack on the surface reached 20 mm. Then the fatigue crack was repaired by gouging and welding and the fatigue test was continued. After repair, the weld toe of the repair weld was UP treated.

The fatigue testing of all specimens demonstrated that the repair of fatigue cracks by welding restores the fatigue strength of welded elements to the initial as-welded condition. Repairing of fatigue cracks a second and a third time also practically restored the fatigue life of repaired welded elements to their initial as-welded condition.

However, when similar samples after the weld repairs were also treated by UIT/UP, the fatigue life of such samples was extended by about four times over the samples that were only weld repaired, thus extending the total life cycle of welded components many times.

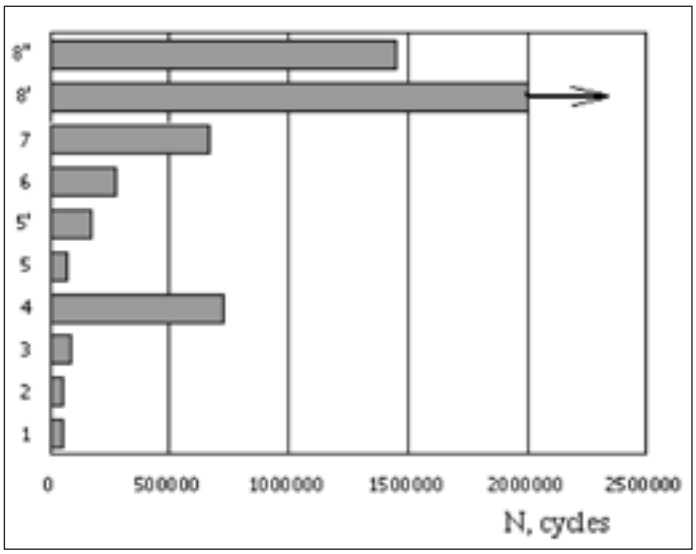

Figure 1: A comparison of the efficiency of different techniques of restraining and repairing fatigue cracks. 1: Initial condition; 2 and 3: Drilling of the crack tips with and without cold working; 4: Drilling of the crack tips with the installation of high strength bolts; 5: Overloading (yield strength); 5' overloading (0.7 yield strength); 6: Local explosive treatment; 7: Local heat treatment; 8': repair by welding with UP treatment of the weld toe zones; and 8": Repair by welding without UP.

Introduction

It is generally accepted that in the total life cycle of welded components the formation and propagation of cracks in welded structures plays a pivotal role. Many approaches exist today for the prevention of crack formation and their propagation [1, 2].

Thus, for instance, in a comparative study to evaluate the efficiency of traditional and advanced techniques for fatigue life improvement of structural elements with fatigue cracks, a number of large-scale specimens containing fatigue cracks were repaired using various techniques and subjected to further fatigue testing [2]. A number of techniques for restraining and repairing the fatigue cracks were evaluated and compared, such as: overloading, drilling of the crack tips, drilling of the crack tips with the installation of high strength bolts, local explosive treatment, local heat treatment, and welding with and without UP on the weld toe zones. The fatigue cyclic testing conditions were zero-to-tension stress cycle (R=0) with the maximum stresses at 155 MPa.

It was found in this study that the repair of fatigue crack by welding with the subsequent UP treatment provided the longest fatigue life in comparison with other ways to prolong the service life of structural elements with fatigue cracks (Figure 1).

As shown, UP treatment can be effectively applied for fatigue life improvement. It was also demonstrated that UP is a very efficient treatment during manufacturing, rehabilitation and repair of welded elements and structures [3-7].

Traditionally, UP treatment is considered in most cases for high-cycle fatigue applications, where its effects are mostly pronounced. It is shown in this paper that in the total life cycle of welded components, in order to achieve the longest possible service time, care must be taken of the welded structures at all stages of the cycle, that is, through manufacturing, maintenance and rehabilitation.

Use of Ultrasonic Peening (UP)

Ultrasonic Peening (UP) is one of the efficient ways of achieving fatigue life improvement of welded elements and structures [8, 9]. The effects of improvement treatments, particularly UP treatment, on the fatigue life of welded elements depend on

the mechanical properties of the material used, the type of welded joints, the cyclic loading parameters and other factors.

For the effective application of the UP, depending on the above-mentioned factors, a software package for optimum application of ultrasonic peening was developed that is based on an original predictive model. In the optimum application, a maximum possible increase in fatigue life of welded elements with minimum time, labour and power consumption is predicted [4].

Manufacturing and rehabilitation

The effectiveness of UP treatment applications to as-manufactured parts and in rehabilitation of parts that have already served a considerable amount of their useful fatigue life was studied. Rehabilitation is considered as the prevention of possible fatigue crack initiation in existing welded elements and structures that are in service. UP was applied to new parts and to parts after 50% of their expected fatigue life.

Three series of large-scale welded samples imitating the transverse non-load-carrying attachments (Figure 2) were subjected to fatigue testing in 1: The as welded condition; 2: After UP was applied before fatigue testing; and 3: After UP was applied after fatigue loading with the number of cycles corresponding to 50% of the expected fatigue life of samples in the as-welded condition [8].

Tables 1 and 2 present the mechanical and chemical properties of the materials used for preparation of the samples. The results of the conducted fatigue testing with UP applied to specimens in the as-welded condition and also after 50% of expected fatigue life are presented in Figure 3.

As can be seen from Figure 3, UP caused a significant increase in fatigue strength of the welded elements for both series of UP treated samples. The increase in the limit stress range at $N=2\times10^6$ cycles of welded samples is 49% (from 119 MPa to 177 MPa) for UP treated samples before fatigue loading; and 66% (from 119 MPa to 197 MPa) for UP treated samples after fatigue loading – with the number of cycles corresponding to 50% of the expected fatigue life of the samples in the as-welded condition.

The higher increase of fatigue life of UP treated welded elements for fatigue curve No 3 could be explained by a more beneficial redistribution of residual stresses and/or 'healing' of fatigue-damaged material by UP in comparison with the fatigue curve No 2.

Use of UIT/UP for weld repair

UP could also be effectively used during the weld repair of fatigue cracks [3, 5]. Figure 4 shows the drawings of large-scale

Mechanical Properties			
σ_y (MPa)	σ_u (MPa)	δ (%)	Ψ (%)
260	450	37.6	63

Table 1: The mechanical properties of base material.

Chemical composition (%)			
C	**Si**	**Mn**	**S**
0.210	0.205	0.520	0.019
P	**Cr**	**Ni**	**Cu**
0.007	0.040	0.040	<0.010

Table 2: The data on chemical composition of base material

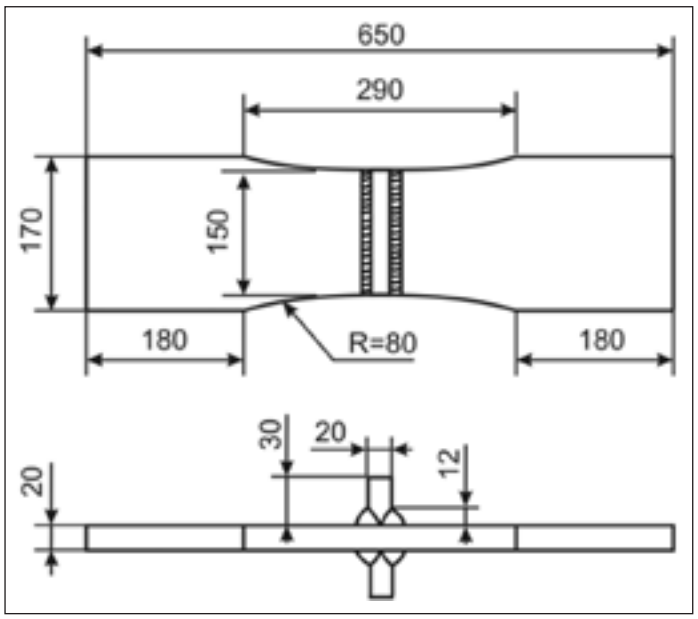

Figure 2: A schematic view of the welded sample used in fatigue testing.

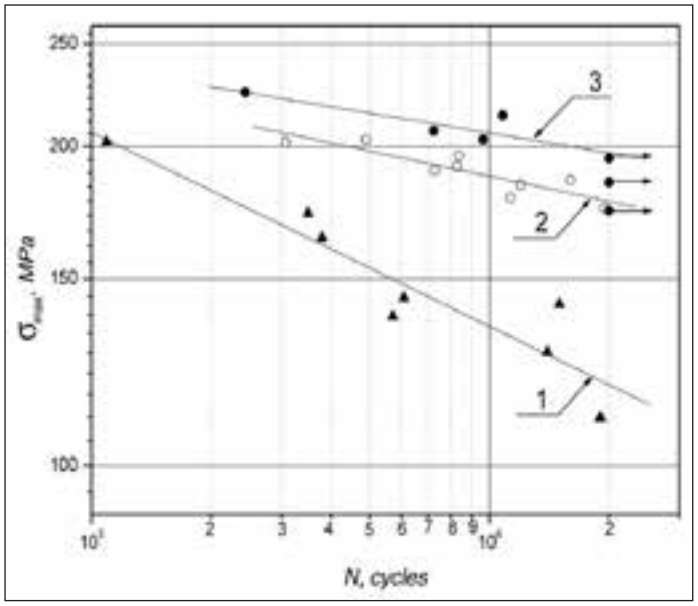

Figure 3: Fatigue curves of welded elements (transverse non-load carrying attachment). 1: In the as welded condition; 2: UP was applied before fatigue testing; 3: UP was applied after fatigue loading with the number of cycles corresponding to 50% of expected fatigue life of samples in as-welded condition.

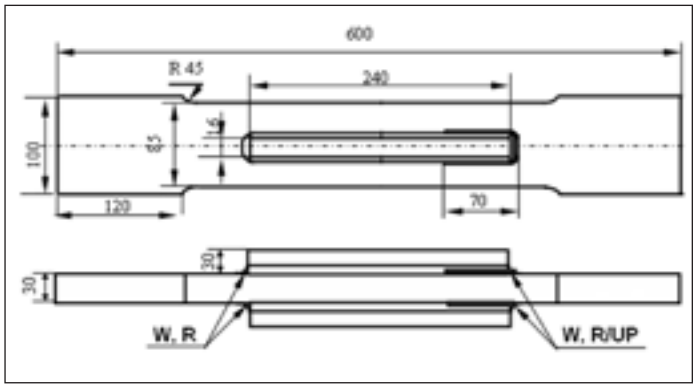

Figure 4. Drawings of the welded specimens for fatigue testing at different conditions: W: As-welded condition; R: Repair by gouging and welding; R/UP: Repair by gouging, welding and UP.

welded specimens containing non-load carrying longitudinal attachments for fatigue testing [3]. These specimens were

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tested in the as-welded condition and after weld repair with and without the application of UP.

The testing conditions were zero-to-tension stress cycles (R=0) with different level of maximum stresses.

The fatigue testing was stopped and the number of cycles was recorded when the length of fatigue crack on the surface reached 20 mm. Then the fatigue crack was repaired by gouging and welding and the fatigue test was continued. After repair a number of samples were subjected to UP. The weld toe of repair weld was UP treated. The results of fatigue testing of welded specimens in the as-welded condition and after weld repair of fatigue cracks are presented in Figure 5.

The fatigue testing of large-scale specimens demonstrated that the repair of fatigue cracks by welding is restoring the fatigue strength of welded elements to the initial as-welded condition. Second and third repairs of fatigue cracks in the same sample also practically restored the fatigue life of repaired welded elements to the initial as-welded condition.

The application of UP after weld repair increased the fatigue life of welded elements by 3 to 4 times. Practically the same significant fatigue improvement of repaired welded elements by UP is also observed after the second and third repair of fatigue cracks in welded elements.

A comparison of the efficiency of weld repair of fatigue cracks with and without the application of UP is presented in the diagram in Figure 6. This diagram illustrates the fatigue behaviour of the same welded elements in cases when UP is not applied (I); when UP is applied after weld repair (II); and when UP is applied before/during the first phase of the service life (III).

Here, one unit of service life corresponds to about 240 000 cycles of loading at the stress range of 158 MPa and to about 75 000 cycles at the stress range of 220 MPa. Every circle, marked R or R/UP in Figure 6 starting from Number 1 on the service life axis, indicates a fatigue fracture and a repair of the welded element. As can be seen from Figure 6, the benefit of the application of UP for weld repair and rehabilitation of welded elements is obvious.

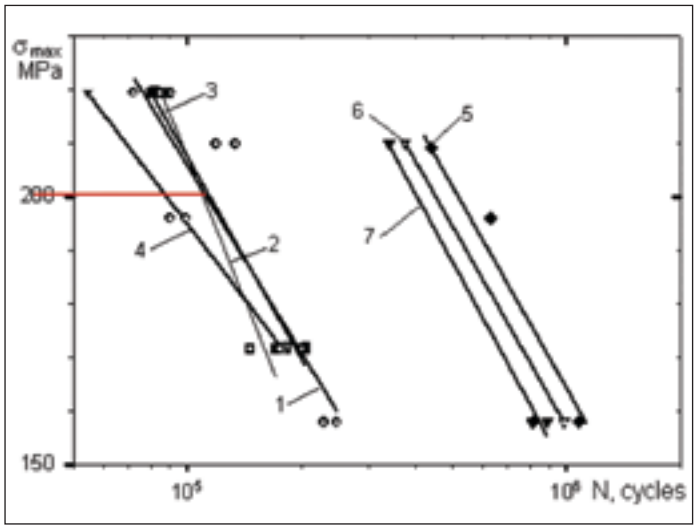

Figure 5. Results of fatigue testing of welded elements: 1 - as-welded condition, 2, 3 and 4 – after first, second and third weld repair, 5, 6 and 7 - after first, second and third weld repair with application of UP

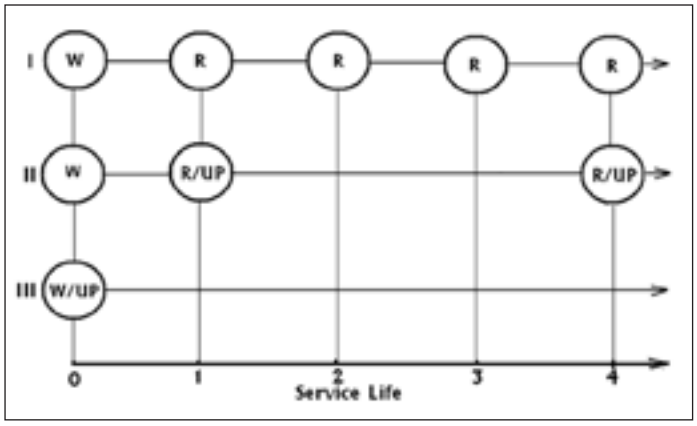

Figure 6: A diagram showing the endurance of the welded element: I: Fatigue crack is repaired by gouging and welding; II: Fatigue crack is repaired by gouging, welding and UP; III: UP is applied before/during the first phase of service life; W: As-welded condition; R: Repair by gouging and welding; R/UP: repair by gouging, welding and UP; W/UP: Welding and UP.

Conclusions

It was shown that ultrasonic peening (UP) could be used effectively in extending the total life cycle of welded components when applied right after manufacturing or in rehabilitation or repair of welded parts.

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Welding Solutions for LNG/LEG

International Welding Technologist, Marco Engelvaart, Global Industry segment manager for liquefied natural and ethylene gas applications (LNG/LEG) at voestalpine Böhler Welding in Germany, talks about his company's solutions for cryogenic LNG applications.

New floating LNG (FLNG) installations will give access to offshore gas fields that would otherwise have been far too expensive or difficult to develop. Photo courtesy of Shell.

Liquefied ethylene (LEG) or methane (LNG) gas is important to the today world's market. LNG/LEG transport and the number of natural gas processing plants and LNG/LEG terminals are still increasing each year.

The present switch to LNG is largely pushed by the low-emission goals in road transportation and industries. Several tests have been run in Western Europe in the use of LNG trucks to deliver their merchandise, which have proved to offer significant advantages, despite the higher investment cost of a LNG-fuelled truck compared to diesel trucks. Advantages for LNG in the transport sector are: cleaner fuel with lower CO_2 emission; lower noise; LNG trucks are allowed in city centres; the price of LNG is stable; and, nowadays, LNG is widely available.

Cryogenic technology is used to produce LNG, where it is cooled down to -163 °C and condensed. By cooling to this temperature at atmospheric pressure, natural gas changes into its liquid form. The volume decreases by 600 times its original volume, making it more attractive for storage and transportation.

Many of the major gas reserves in the world are to be found far away from the end-users. Examples of current locations with large gas-reserves are: Algeria, Australia, Indonesia, Qatar, Nigeria, Angola, Mozambique; and the shale-gas fields in North America, which is soon to be one of the major global LNG suppliers.

Storage tanks for LNG generally have double walls, which have insulation between them. The inner wall is principally made of 9% Ni steel. Land-based LNG tanks tend to be cylindrical with a suspended deck. These tanks have been built with a capacity of up to 180 000 m^3 each.

The LNG tanks for transport carriers come in different shapes and materials. Four types of containment systems are in use for new-build vessels, independent types A, B and C. Types A and B are the self-supporting (independent) types – Moss (aluminium sphere type) and IHI (prismatic) – while the cylindrical type C uses the shape of the hull of the carrier ship more efficiently (made of 5% Ni Steel for LEG) or 9% Ni steel (for LNG). The remaining type: (integrated) membrane tank types proposed by GTT are manufactured in stainless steel and 36% Ni steel (Invar).

Horizontal-vertical submerged arc welding of a tank.

Parent metal and welding

Especially with regard to toughness requirements at low temperatures, the storage and handling of various liquid gases places great demands on mechanical properties. In general large land-based storage tanks have their inner walls made of steel alloyed with 5-9% nickel. Tanks aboard vessels use a larger variety of alloys, such as aluminium, stainless steel and 5-9% nickel steel.

Piping systems and tanks for other transport limit themselves to austenitic stainless steel. Some pipe manufacturers produce submerged arc welded 9% Ni pipes using matching consumables. Depending on the final requirement of toughness, these welded pipes need to be heat-treated in order to obtain the specified toughness values.

Impact toughness testing (Charpy V) in LNG applications is normally carried out at −196 °C, which can be achieved by cooling down with liquid nitrogen. Apart from minimum impact toughness at −196 °C, lateral expansion is the most commonly specified requirement for

describing low temperature toughness behaviour of a metal.

Simply explained, lateral expansion is a measure of the plastic deformation of a material during impact testing. The most common requirement for lateral expansion is a minimum of 0.38 mm. There is in general a linear correlation between impact toughness and lateral expansion. The higher the impact toughness (joules, J), the higher the value of lateral expansion. This correlation is also influenced by the welding process and slag-systems.

Welding of 9% Ni Steel

The 9% nickel steels used in LNG storage tanks are quenched and tempered or so-called double normalised and tempered. The latter involves heat treatment in which the steel is heated to the two-phase region several times and thus undergoes partial austenitising. During this heat treatment, the small austenite areas absorb, through diffusion, large amounts of the available carbon and nitrogen. Consequently, carbon and nitrogen contents in the martensite/ferrite are reduced and both hardness and brittleness are decreased. The high carbon and nitrogen contents also contribute to the austenite areas remaining stable at lower temperatures. This gives the steel its excellent toughness at cryogenic temperatures. Martensite that is not converted into austenite is, of course, also tempered during heat treatment, thereby also contributing to the increased toughness of this phase of the structure's material.

When it comes to welding 9% nickel, the options are matching and non-matching filler metals. For nearly all actual fabrication, non-matching fillers are chosen. This is due to the need to match the thermal expansion of the parent material, while optimising the weld metal strength. Nickel alloys match this requirement closer than stainless steels.

Welding must be done with the parent plates fully restrained to prevent weld strength being lost after distortion.

9% Ni steel can be prepared for welding by flame cutting and grinding. Weld joints need to be slightly wider than for conventional steels to ensure good root access and to accommodate the sluggish behaviour of the nickel-based welding consumable. The most commonly applied welding methods are SMAW, SAW and FCAW and depending on the region, GTAW. The strong magnetic nature of 9% Ni can pose arc blow problems, which can be controlled by applying alternating welding current (ac) and by demagnetising on site. Preheating of the weld zone is not necessary although the maximum inter-pass temperature should be limited to a maximum of 150 °C.

In tank construction, stick electrodes and flux-cored wire are predominantly used for vertical (PF, 3G) welds and submerged-arc welding for horizontal (PA, 1G) and horizontal-vertical (PC, 2G) welds.

Because the 9% nickel steels contain a certain amount of austenite, there is little risk of hydrogen cracking. Filler metals that give an austenitic or nickel-based weld metal absorb hydrogen easily. Nonetheless, to minimise the width of the heat-affected zone (HAZ), the heat input during welding is usually restricted to 2.0 kJ/mm. The HAZ is kept as narrow as possible because the favourable structure of the parent metal would typically be destroyed here.

Another welding recommendation is applying multi-pass welding to achieve 'weld normalisation' of the HAZ. For the weld metal to acquire the desired toughness at low temperatures, nickel-based filler metal must be used. For welding of 5% and 9% Ni steel, the most commonly used consumables are covered

Steel	Welding 5% Ni steel		Welding 9% Ni steel	
DIN EN ISO 15609-1	AWS- Norm	Product (and current)	AWS-Standard	Product (and current)
SMAW process 111	E316L-15 (Mod)	Thermanit 19/15	E NiCrMo-6	UTP Soudonel D (AC/DC+)
	E NiCrMo-6	UTP Soudonel D (AC/DC)	E NiCrMo-3	UTP 6222 Mo (DC+)
	E NiCrMo-6	UTP 7013 Mo (AC/DC)	E NiCrMo-6	UTP 7013 Mo (AC/DC+)
SAW process 12 Wire/flux	n.a.	Thermanit 17/15 TT + Marathon 104 Thermanit 19/15 + Marathon 104	ER NiCrMo-3	UTP UP 6222 Mo + UTP UP Flux 6222 Mo (AC/DC+) Thermanit 625 + Marathon 104 (AC/DC+)
	ER NiCrMo-4	Thermanit Nimo C276 +Marathon 104 (AC/DC 1,6 mm and AC 2,4 mm)	ER NiCrMo-4	Thermanit Nimo C276 +Marathon 104 (AC/DC+ 1,6 mm and AC 2,4 mm)
GMAW process 135	n.a.	Thermanit 17/15 TT (DC+)	ER NiCrMo-3	UTP A 6222 Mo (DC) Thermanit 625 (DC+)
FCAW process 136	ENiCrMo-3 T1-4	UTP AF 6222 Mo PW (DC/AC)	ENiCrMo-3 T1-4	UTP AF 6222 Mo PW (DC+/AC)

Consumables for welding 5% and 9% Ni tanks.

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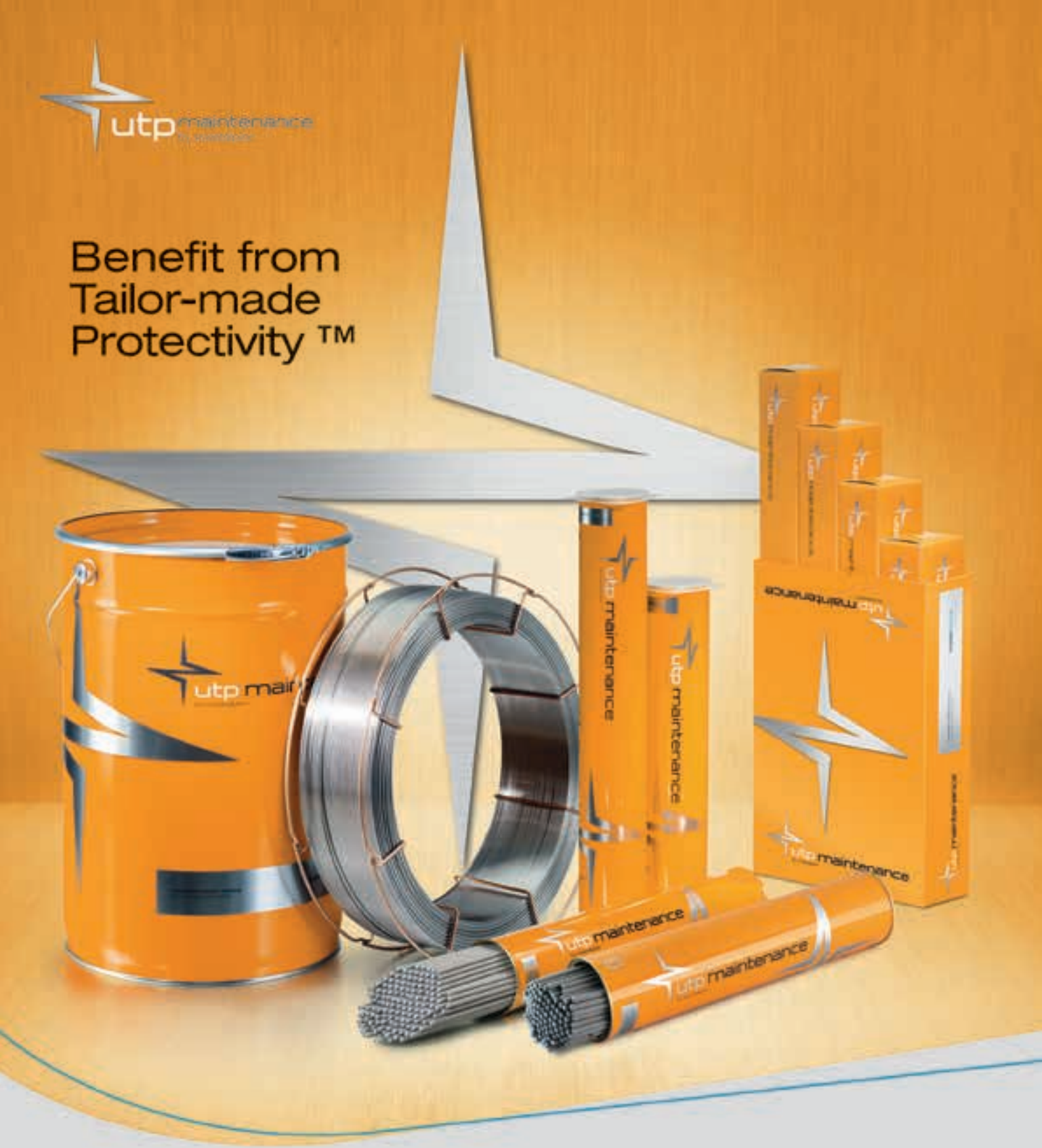

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electrodes, or flux-cored wires. Solid wires for the MIG process can also be used but requires very skilled welders and/or operators due to the high risk of lack of fusion.

Examples of classifications of filler metals that give an austenitic stainless steel weld metal are E 18 14 Mn 6 SMAW electrodes for 5% Ni steel; E NiCrMo-6 SMAW electrodes for producing nickel-based weld metal; and for the submerged arc welding process, ER-NiCrMo-4 can be used for both 5% Ni and 9% Ni steel.

Mechanical requirements and project specifications for the parent material, all weld metal and the welded joints may include: Yield Strength, Ultimate Tensile Strength, Cross Tensile Strength, Elongation Side Bend Test, Impact Toughness (CVN), lateral expansion, shear fraction and CTOD.

Typical requirements for the weld metal as specified in welding consumable specifications for welding 9% Ni steel are:

- Yield Strength: > 430 MPa.
- Ultimate Tensile Strength: 690-825 MPa.
- Elongation: > 35%.
- Impact Toughness (CVN): > 70 J @ −196°C.
- Lateral Expansion: > 0.38 mm @ −196°C.
- Shear fraction: > 80% @ −196°C.
- CTOD: > 0.30 mm @ −165°C /−196°C.
- Side bent tests, hardness measurements.

Properties in weld metal can be safely met, but the following points must be taken into consideration:

- The restraint condition due high strength of 9% Ni steel: Welding must be done with the parent plates fully restrained or else weld strength will be lost after distortion.
- The Ni-based filler metal shows hot crack tendency.
- Restriction in heat input is required.
- Maximum inter-pass temperature must be respected <150 °C.
- Control of dilution.
- Magnetic arc blow.
- The end result may be close to the technological strength limit of the weld.

Filler metals, as well as welding parameters, have to be selected to satisfy all of these features.

Quality assurance activities have to be established as well welding, consumables and checking procedures in accordance with the specifications before they can used for an LNG project.

Product	Welding Process	Rm (Mpa)	Rp 0,2 (Mpa)	Elongation (%)	Toughness @ −196 °C (J)
UTP 7013 Mo	SMAW	714	441	43	98 – 100 – 100
UTP Soudonel D	SMAW	709	429	36	87 – 75 - 75
UTP AF 6222 Mo P-W	FCAW	749	505	44	78 – 77 - 76

Mechanical data of all weld metal for SMAW and FCAW products for welding 5% and 9% Ni steels.

All weld metal	Test results	
AWS class.	ENiCrMo3 T1-4 / Alloy 625	
Wire Diameter Polarity Shielding gas	1,2 mm DC+ Ar + CO_2 (20%)	
Tensile test Position	Pure Weld metal 3G / 1G	
Rp 0,2 at RT (MPa)	489	514
Rm at RT (MPa)	764	761
Elong. (%)	37	44
Av (J) @ -196°C	80/92/80/85/88	75/69/75/73/70

Results of tests welded with flux cored wire UTP AF 6222 Mo-PW in vertical up and downhand positions.

An SMAW electrode (such as UTP Soudonel D) with a fully nickel core allows a higher current to be carried, which produces a higher deposition rate. Whereas a covered electrode with an alloyed core wire gives higher toughness results (UTP 7013 Mo), however this electrode needs to be welded with a lower current.

A more recent development is the use of a 625-type alloy flux-cored wire, UTP AF 6222 Mo-PW, for welding joints in 5-9% Ni Steels in the vertical up position. The slag, which is produced during welding offers good protection against oxidation, good support for the solidifying weld pool, excellent weldability with very low spatter and excellent bead appearance.

The mechanical properties of the weld deposit are also aligned with requirements. Furthermore, the flux-cored wire offers a higher deposition rate and hence higher cost efficiencies compared to coated electrodes under the same conditions. Cost savings of up to 30% can be achieved, despite the higher price/kg of the flux cored wire.

A test plate of the flux-cored wire UTP AF 6222Mo-PW (AWS A5.34 ENiCrMo3 T1-4) welded in vertical-up position.

Aluminium

Most aluminium alloys show very little change in mechanical properties at cryogenic temperatures when compared to room temperature properties. In general, strength increases slightly at cryogenic temperatures, while impact toughness remains roughly the same and elongation decreases a little.

The strongest argument for using aluminium as a construction material is its low weight. The strongest arguments against its use are: the price; the relatively poor elongation compared with steel grades employed in these applications; and aluminium's low resistance to fire.

Despite the materials' poor elongation properties, ASME has approved alloys 5083 and 5456 for pressure vessels in the range from −196 °C to +65 °C. The alloys most usually considered for non-pressurised cryogenic applications are 1100, 2014, 2024, 2219, 3003, 5083, 5456, 7005, 7039 and 7075. However, 5083-O is the aluminium alloy mostly used for cryogenic applications. Böhler S-Al Mg 4.5 Mn is an example of a suitable filler metal four use with the GMAW and GTAW welding processes for welding 5083-O.

The general aluminium welding

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recommendations apply here too: thorough oxide removal and cleaning, quick welding with a high heat input; etc. However, the reduced strength in the HAZ should be taken into account and weld joints positioned and designed accordingly. Strength of the age-hardenable (precipitation hardening) alloys (2xxx, 6xxx and 7xxx grades) can be reduced by up to 40% and of the non-hardenable grades (strain hardening/cold working) up to 50% depending on their condition before welding. Solution heat treating and aging can be an option, if possible, for the age-hardenable alloys to recover their strength after welding.

Austenitic stainless steel

Austenitic steel such as 304L and 316L demonstrate good impact toughness values down to −196°C. These ordinary stainless steels are relatively easy to weld. However to optimise the properties of the joint, the heat input is normally held to a maximum of 2.0 kJ/mm. The weld metal composition, weld geometry and how the weld-metal solidifies demand great precision. These variables (weld metal chemical composition in particular) affect whether the desired impact toughness is achieved and whether hot cracking can be avoided.

A further affecting parameter is the delta-ferrite content of the weld metal. This must be sufficiently low for the weld metal to satisfy the impact toughness test at −196°C and high enough for solidification to be primarily ferritic in order to avoid hot-cracking.

Chromium (Cr), molybdenum (Mo) and niobium (Nb) promote ferrite formation while carbon (C), nickel (Ni) and nitrogen (N) promote austenite. It is the balance between these that largely determines the ferrite content. Nonetheless, other factors such as extremely fast or slow cooling are also important. In certain cases, when welding with covered electrodes (SMAW), for example, the arc/weld pool can take up nitrogen (N) from the air – especially when welding with long arc lengths, which is influenced by the welder. Ferrite content can then be low and hot cracks could occur as a result.

Also, when submerged arc welding (SAW), chromium (Cr) can be burnt off in the weld pool due to long stick-out and high arc voltage, for example, the same problems may arise.

It is, however, micro-slag content, measured through chemical analysis of the oxygen content, that has the greatest effect on the ability of the weld metal to satisfy the impact toughness requirements at −196°C.

Generally speaking, the gas-shielded GTAW and GMAW processes using solid wires give a metallurgically clean weld deposit that has no problems satisfying the requirements. The slag forming processes (SMAW, FCAW and SAW) do not usually give a weld metal that is as metallurgically clean (micro-slag), which can make it difficult to meet the requirements of impact properties and lateral expansion. This is normally no problem with the specially designed welding consumables for low temperature applications from voestalpine Böhler Welding.

The non-ferrite consumable types give a fully austenitic weld metal and can be used, for example, when low magnetism is a desired feature of the weld.

The consumables in the table above have been developed according the voestalpine Böhler Welding's high quality standards. Consequently, weldability is excellent in flat position welding and outstanding when used for positional welding.

All of the products listed in the table produce a weld deposit that will produce good impact properties down to −196°C. Specific product data can be found in the product datasheets on www.voestalpine.com/welding.

In the past the only option for producing a weld metal with good toughness at cryogenic temperatures was to use basic electrodes (of the E3xxL-15 type), which are not generally considered to be user-friendly. However, there are now options that make welding far easier and which give good results. The Avesta rutile/rutile-acid covered electrodes (E3xxL-16, mentioned in above table) for welding the austenitic steels 304 L and 316L offer better weldability and superior results along with smoother transitions to the parent metal and improved slag detachability.

These products have been applied in Shell's Prelude Floating LNG plant, which is the first plant of its kind globally and its stainless steel pressure vessels are welded using voestalpine Böhler Welding consumables: SMAW: Avesta 316LSKR Cryo; FCAW: Avesta 316L/SKR Cryo; TIG: Avesta 316L/SKR; SAW: Avesta 316L/SKR + Flux 807

Welding in cryogenic applications determines, to a large extent, the structural integrity of the total construction of the LNG terminal or LEG/LNG carrier. It is therefore very important to evaluate the welding processes that can be applied as well as the possibilities in terms of the type and chemical composition of the consumables.

It needs also to be stated that research in the energy-segment is continuing and there is much to indicate that LNG and LEG represent a step on the road to reduced emissions. New processes and materials will be tested and eventually used. In turn, this will require the welding industry to play its part in future development. One example has been given in the new floating (FLNG) installations, a new technology that will give access to offshore gas fields that would otherwise have been far too expensive or difficult to develop.

Product	AWS	Process	Ferrite Number	Lateral Expansion	Toughness @ −196 °C (J)
Böhler EAS2-IG	ER308L	GTAW	8-11	1,17	112
Böhler Fox EAS 2	E308L-15	SMAW	4-8	1,06	66
Avesta 308L/MVR Cryo	E308L-16	SMAW	3-8	0.55	35
Böhler EAS 2 PW-FD (LF)	E308LT1-4 E308LT1-1	FCAW	3-6	0,75	45
Böhler Fox EAS 4 M (LF)	E316L-15	SMAW	5-7	0,60	67
Avesta 316/SKR Cryo	E316L-16	SMAW	3-8	0,70	42
Böhler EAS 4 PW-FD (LF)	E316LT1-4 E316LT1-1	FCAW	3-6	0,60	40

Special designed, mostly low-ferrite filler metals for LNG applications with typical values.

References:

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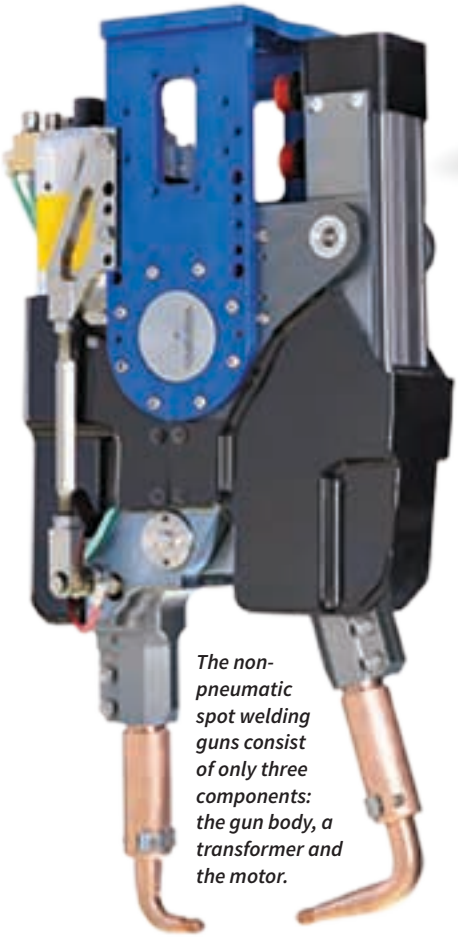
Modern industrial spot welding solutions

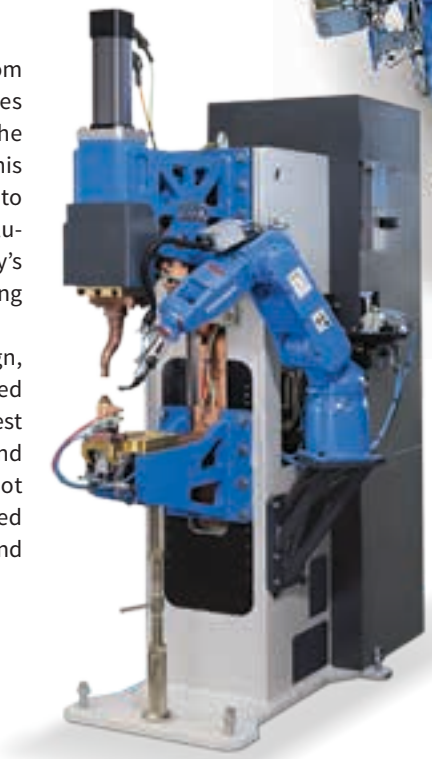
Yaskawa has developed a compact and flexible system for high-speed robot-based spot welding. The modular solution comprises a cell with positioner and two spot welding robots; particularly lightweight spot welding guns; a nut welding machine and a full range of accessories.

The success of an idea comes from an approach that undermines tradition. Yaskawa, sure of the high quality of its products, took this approach to go beyond robots and to create a complete spot welding solution that has revamped the company's automotive and vehicle-manufacturing offering.

Today, Yaskawa is able to design, build, install and service robot-based production cells that meet the highest standards in terms of technology and innovation. The company's new spot welding solution is a fully integrated welding system with a positioner and onboard robots. It is available with small welding robots (MS and VS Series), Yaskawa's light welding gun, along with jigs and a nut-welding machine.



The non-pneumatic spot welding guns consist of only three components: the gun body, a transformer and the motor.



The nut-welding system can be attached to the right or left of the spot welding cell with a dedicated handling robot (MH5) attached to the side structure.

The innovation is a holistic approach to spot welding, one that focuses on solving problems rather than supplying individually branded products.

The advantages of this modern spot welding solution for users include:

- The compact footprint: space savings up to 40% can be achieved.
- Full control of the solution, thanks to all of the tooling and equipment coming from a single source, ie, Yaskawa.
- Improved accessibility to the parts being welded.
- Easy to move: the system is on a common base making it a single moveable machine.
- Easy to install: very little set-up time by the customer is required and there is no re-teaching requirement once the system arrives on site.
- Easy to program with an ergonomic working position for the operator.
- Flexible concept: The system is 100% flexible and 100% customisable.
- The onboard robot at the front can easily load the item without interference.
- It is faster than ever, giving savings with respect to cycle time.

At the start of the ordering process for a Yaskawa spot welding system is a turnkey design and selection process, starting with the analysis of the specifications. Pre-design and drafting of the proposal then proceeds, followed by the layout of a solution and simulation of its use.

The process takes full advantage of lean manufacturing and traceability to give the shortest production times possible. Following line assembly and installation, the system will be inspected, tested and commissioned. Ongoing maintenance and spares are also available worldwide, to ensure reliability and minimum downtime.

Spot welding gun range

The new range of spot welding guns for the system was developed to be exceptionally lightweight. Carefully designed down to the smallest detail, these en-

Yaskawa's new robot-based spot welding cell is a holistic approach to spot welding, one that focuses on solving problems rather than supplying individually branded products. Use the SnapScan QR code to access an excellent online video.

able robots with lower capacities to be used. Yaskawa also make a wide range of guns with different openings, reach and wrist mounting, to best suit the items to be welded.

The non-pneumatic spot welding guns consist of only three components: the gun body, a transformer and the motor. This offers maximum simplicity and ease of maintenance and connecting cables are routed to ensure better rotation of the wrist of the robot.

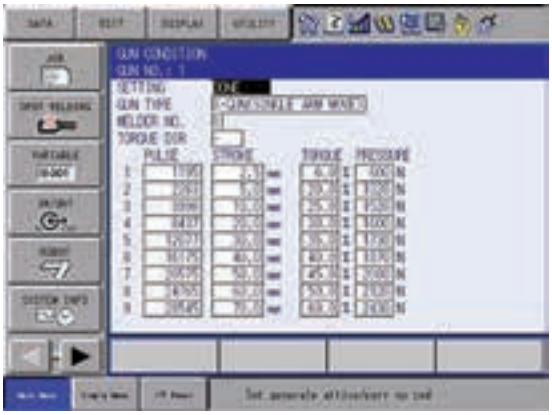
The lightweight system offers lower energy consumption and the guns can be mounted onto robots with lower carrying capacity. The guns are easy to install and maintain and offer more standardisation with wider range of customisation options.

Nut-welding machine

The nut-welding machine is a new addition designed and manufactured by Yaskawa to enable all of the necessary welding to be completed in this single spot welding cell.

The unit can be attached to the right or left of the machine, depending on needs, with a dedicated handling robot (MH5) attached to the side structure. A vibrating servicing cabinet conveys nuts, bushes or pins to the handling robot. When in position, these can be picked up by the handling robot, which places them in position on the part.

The servomotor then brings the nut-welding tool into contact with the item and, like spot welding, through pressure and current flow the nut, bush or pin is welded onto the sheet metal part.



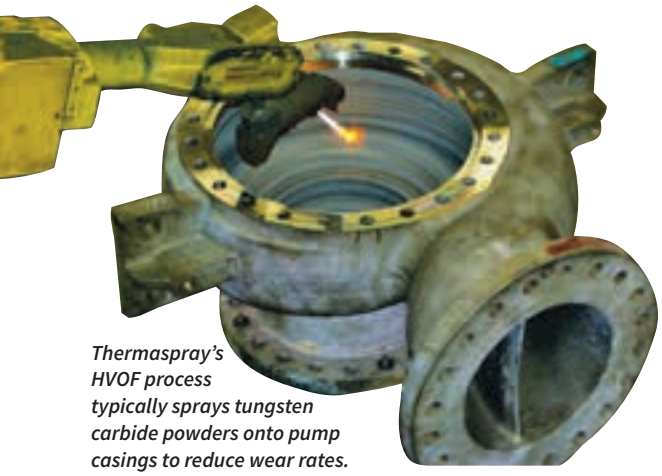
Yaskawa's MotorGun software features: easy set up to configure communication with the welding timer; easy calibration, with a dedicated calibration page for the gun and motor; and self-learning functions.

Yaskawa's new high-speed robot-based spot welding cell comes complete with its power sources in a welding cabinet and Yaskawa's MotorGun communication software for controlling the weld timers and gun motors. This guarantees high quality welding due to the integration and dialogue between all of the interconnected Yaskawa systems.

Coating solutions for the sugar industry

South Africa's surface engineering and thermal spray coating technology specialist, Thermaspray, offers a range of high quality coating techniques that assist the sugar industry in reducing maintenance costs by protecting both new and worn equipment parts and components against abrasive, adhesive, erosive and corrosive degradation.

Maintenance costs for the multiple-process sugar industry, comprising crushing, refining and packing of cane and beet sugar, can make up as much as 10% of the value of goods produced. Equipment maintenance as a direct result of abrasion, adhesion, erosion and corrosion leading to rapid wear and corrosion and subsequently expensive downtime can account for up to one third of plant maintenance costs, including replacement and/or repairs.



Thermaspray's HVOF process typically sprays tungsten carbide powders onto pump casings to reduce wear rates.

Thermaspray managing director, Jan Lourens, notes the importance of using a specialist coating company such as Thermaspray. "As a DQS ISO 9001 Quality Management and Eskom level 1 certified company with close to 20 years' experience in wear- and corrosion-resistant thermal spray coatings, we possess the necessary capabilities and knowledge of the correct coating techniques and applications using best practices as well as quality control of coating processes that are fundamental to ensuring successful results. The excellent protection offered by our superior quality, highly dependable coating solutions against surface wear and corrosion delivers numerous cost saving benefits including: the enhancement of equipment lifespan; a reduction in downtime, replacement and maintenance costs; and improved equipment and plant uptime, productivity and production."

Methods applied by Thermaspray to overcome abrasion, adhesion, erosion and corrosion in the sugar industry include thermal spraying – a generic term used to define a group of processes that deposit fine metallic or non-metallic materials onto a prepared substrate to form a coating – Plasma Transferred Arc (PTA) welding, cladding and hardfacing – a versatile method of depositing high quality metallurgically fused deposits on relatively low-cost substrates; and polymer applications.

Thermal spraying

Thermal spaying involves projecting coating materials in powder, rod or wire form onto a prepared surface. Molten or softened particles are applied by impact onto a cold substrate, resulting in layer of surface material bonded at the interface and between the particles through a combination of mechanical interlocking and diffusion bonding.

A common feature of all thermal spray coatings is their lenticular or lamellar grain structure resulting from

Burnishing and degaussing processes for spray coatings

Burnishing, de-magnetisation and measuring of electrical run-outs by thermal and plasma coating solutions specialist, Thermaspray, aids with improving the mechanical reliability of rotating equipment inside motors and generators resulting in reduced failure risks, extended component life and improved uptime.

In-service monitoring of both mechanical and electrical run-out will improve the mechanical reliability and reduce the risk of failures and subsequent costs of motors, generators, lower shafts and bearing housings.

Discussing the two types of run-outs, metallurgical engineer at Thermaspray, Shaik Hoosain, explains that the mechanical run-out is measured using a dial indicator in contact with the rotating shaft and is not done in-situ. In the case of bearings, run-out will cause vibration of the machine and increased loads on the bearings, which may lead to premature failure.

Electrical run-out is used to measure the deviations in the electrical properties of the shaft material as it rotates and is measured using eddy–current proximity probes. These probes can be used in-service on the shafts connecting motors and generators, for example. "Eddy current proximity probes measure and monitor the relative vibration or motion between a shaft and its stationary bearing surface," Hoosain explains.

Electrical run-out is concentrated around the metallurgical variations around the circumference of the shaft where these metallurgical variations lead to electrical conductivity and magnetic permeability of the shaft affecting the probe's track signal. Sources of electrical run-out include metallurgical variations or changes caused through forging, heat treatment, grinding, magnetism, stress effects, handling and plating processes.

For a true and accurate in-service measurement, the electrical run-out is measured and corrected prior to the assembly of the equipment. "We measure and correct electrical run-out through a process called burnishing that involves the rolling of a blunt tool against the surface of a work piece with a force being applied by the tool," continues Hoosain.

Metallurgically, burnishing is a cold working process that improves the surface characteristics of components and is mainly performed on materials to improve the surface strength and roughness. As soon as the yield point of the material is exceeded, plastic deformation occurs which leads to a smoother surface profile.

Burnishing is performed by revolving the final ground/machined part in a lathe and using a diamond-burnishing tool. The probe track area, where the run-out is measured, is cold worked to ensure a perfectly round, parallel and smooth surface. After completion of the burnishing process, the residual magnetism in the part, measured using a residual field indicator and a Gauss meter, is removed using demagnetising coils.

After the burnishing process, electri-

the rapid solidification of small globules, flattened from striking a cold surface at high velocities. The different processes include:

- **High velocity oxy-fuel (HVOF):** This process operates on a continuous steady-state basis with continuous powder feed. Thermaspray offers two processes, gas and liquid fuelled.
- **Wire Arc Spraying:** Also known as the twin-wire arc spray process, in this thermal spray process a direct current (dc) electric arc is used to melt the feedstock. Compressed air behind the arc is then used to atomising the molten material. Higher thermal efficiency is achieved as wires are melted directly. Coatings are coarse with higher porosity.
- **Powder plasma spraying:** Plasma, the 4th state of matter, consists of neutral and positive atoms and free electrons. Plasma gases are heated as they ionise in the arc and high degrees of melting and relatively high particle velocities are achieved. Finely structured coatings with high adhesion strength can result.

Plasma Transferred Arc (PTA) welding and hardfacing

This is a versatile method of depositing high quality metallurgically fused deposits on relatively low cost substrates. Both the surface material and the coating material are melted during the process. PTA permits precise control of important welding parameters, such as powder feed rates, gas flow rates, amperage, voltage, and heat input, ensuring consistency. Controlled heat input ensures that weld dilutions can be controlled to between 5% and 7%.

Polymer applications

- **Plasma Coatings (non-stick and traction coatings):** Thermaspray has undertaken a strategic partnership with Plasma Coatings in the USA to offer the South African market a new range of surface technologies and coatings to tackle the sugar, food, printing and packaging, tyre and rubber, paper and pulp, fempro/diaper and many more industries. These coatings are designed to solve many of the above industries' problems resulting in reduced maintenance, higher outputs and an increase in cost savings. These coatings combine the advantages of thermal spray (metal base) coatings with polymer top coatings to offer benefits of wear resistance, slip and traction. These coatings can be applied to aluminium, steel, stainless steel, tool steel, copper, ceramics as well as synthetic materials.
- **Diamant Metalplastic (polymeric solutions):** Thermaspray is the exclusive Southern African representative of German-based DIAMANT Metallplastic GmbH. DIAMANT Metallplastic offers the metalworking industry high-quality polymeric solutions to restore functionality to castings, thereby significantly reduce scrap. The DIAMANT polymeric solution includes products for impregnating and sealing leakages, repairing of blow holes and surface treatments as well as wear protection and services.

Typical applications in sugar industry include knife and trash plate replacement components in sugar mill, shredder hammers, crushers rolls, scrapers, pump casings, conveyor screws, valves covers, flanges and bearings and bearing journals.

Thermaspray, in a joint venture with Cape Town-based Surcotec, offers an extensive portfolio of engineering and thermal spray coating solutions that extend component life cycles to assist OEM and end-user clients across southern Africa in reducing costs and increasing production.

The company's world-class quality wear- and corrosion-resistant thermal spray coatings, Plasma Transferred Arc (PTA) cladding and Polymer coatings are augmented by a host of specialised allied services.

cal run-out can be measured using an electrical run-out indicator apparatus on a lathe or inspection bench. Electrical run-out is measured every 1.0° through 360° and plotted on graphs using specialised, calibrated equipment and applicable software.

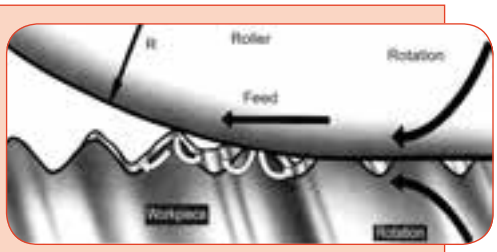
Discussing eddy-current proximity probes for shaft vibration monitoring, Hoosain says that the probes are positioned over a specially machined probe track area adjacent to each bearing journal. The signal from the eddy-current proximity probe is a function of the gap between the probe tip and the target material. If the run-out changes in service, the difference is registered by the probes and will indicate to operators and engineers that the equipment is damaged – worn, out of balance or poorly lubricated, for example.

Surface imperfections such as scratches, out-of-roundness or non-concentricity with respect to the bearing journal are mechanical imperfections, which will appear as vibrations that will result in measurement errors. These will be picked up as signals by the eddy-current proximity probes.

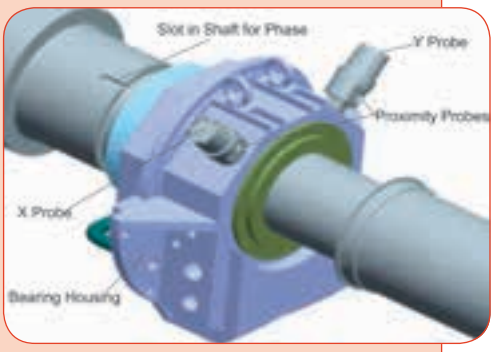
Burnishing is used to improve run-out measurement reliability, which can significantly improve the in-service condition-monitoring accuracy for rotating equipment.

Typical equipment using probe tracks include boiler feed pumps, 50% boiler feed pumps, turbine rotors, compressor rotors, blower rotors, pinion shafts and cryogenic pump rotors.

Burnishing, de-magnetisation and measuring of electrical run-outs are all routinely performed in Thermaspray's well-equipped workshops according to the relevant ISO standards.



A schematic representation of the burnishing process, which improves surface strength and reduces roughness. Plastic deformation occurs which leads to a smoother surface profile.



The typical arrangement of eddy-current proximity probes for shaft vibration monitoring.

Plant maintenance - An early

In this new column from South Africa's Institute for NDT, SAINT, president Keith Cain remembers the early days of shut-downs and RTS projects and draws some lessons about the importance of better planning, leadership, recording and reporting.

During my 19-year career in NDT, I have had the valuable opportunity to be part of four shutdowns at a petrochemical plant and a return-to-service (RTS) project at a power station. This is a short collection of my experiences at these shutdowns/projects.

Way back when at these petrochemical plants, and just qualified in a few NDT methods, I attended my first shutdown. We were very green then, with zero experience in inspecting tanks, heat exchangers, piping and other related equipment. The inexperience was compounded when told to use a plant layout drawing to find the specific equipment that we had to inspect. At the onset of the shutdown, the drawing was usually only A3 in size but after a lot of begging we were able to get a bigger one.

A lot of time was spent initially looking for equipment within the plant that we had to inspect. Soon we got into the habit of observing and mentally recording the tag numbers of the vessels that were situated within the plant during our work and walking to and from the plant. The acronyms TK, VL, and EX became our second language.

If a planned Scope of Work existed, it was never shown to us. We often followed verbal instructions that were given to us by the inspection group's site 'Crew Chief'.

We were often given the choice to inspect any of the internal welds of the equipment, and only sometimes did a Competent Person (CP) or Inspector of Pressurised Equipment (IPE) point out a specific area. We soon learned that these inspectors were very experienced and did not usually suffer fools, so we tried to stay out of their way.

No critical welds were initially identified, as we didn't know which was which. Naturally our first shutdown experience helped us during our second one. It was assumed that we knew exactly what to do; hence no procedures/work instructions were supplied. We were left pretty much to carry on alone.

During the last few remaining days, locating the Pressure Relief Valves (PRVs) proved to be quite a challenge, as they weren't indicated on any of the drawings at that time. We spent quite a few hours again climbing up to the top of normally very tall vertical vessels (VLs) to try to spot the PRVs that, fortunately, were usually silver in colour. We had to ensure that all the wire seals and ID tags were present, with the correct flange fasteners being secure and in place, and then spray a section with bright orange dayglo paint. Sometimes we would get three quarters of the way up a VL to get to a PRV only to realise that someone else had been there previously and not sprayed enough paint to mark it properly.

Ultrasonic testing (UT) taking place in a three flanged piping manifold.

Often there were 'hurry up and wait situations'. You were told that a vessel was ready for NDT only to get to the vessel and discover that no surface preparation (sand blasting) had taken place, or the manhole watcher (safety watcher) had gone walkabout, or something was not right with the work permit. We soon stopped carrying all of our equipment the first time around, preferring to first do a 'recce' to ensure that everything was ready before returning to collect our equipment.

In the early days of the shutdown most of the material thickness testing was undertaken while on scaffolding – and wearing of safety harnesses was not required in those days. Soon into the shutdown, the fitter crews used to remove the heat exchanger domes in order to gain access to the tube bundle plates. We often had to jump over the gap in the scaffolding planks to get to the welds in question, as the fitters had removed some of the planks. Most of the time, the actual wall thickness location measurements on the equipment did not match that indicated on the supplied drawings from a previous inspection, so new holes had to be made in the existing insulation to get to the surface. The drawings could not be revised.

I remember having to stand in large droplets of mercury when inspecting two other heat exchangers after the tube bundles had been removed from the shells. Often, before entering a vessel, the spaghetti clump of airline pipes had to be untangled to select the best one to use before climbing through the manhole into a vessel.

On one specific plant, we had to wear overalls, a raincoat and a 'baby-grow' suit over everything with PVC rubber gloves protecting our hands. We also used an airline to feed fresh air

NDT perspective

through to a full-face mask. When on top of a four level scaffold within a large vertical tank, one's thoughts tend to go in the 'what if?' direction. If you suddenly lose all air supply, what do you do? Our options were limited; hold your breath and climb down the scaffolding or remove your mask and egress the vessel without too much speed. The process controllers told us the fumes within the vessels would kill you in a very short time should you inhale them.

During the last few days of my first shutdown, we were asked to start providing NDT reports. This proved to be quite interesting as we had not made any notes or recorded what vessels we had inspected beforehand. It then became necessary to go back to each vessel and try to recall what weld and configuration/type thereof we had inspected. This information had to be transferred to a drawing of the vessel that did not always show all of the welds in the vessel's construction.

At the power station, the system worked differently to that of petrochemical. We had to draw up a turbine inspection quality control plan (QCP) from an example that was provided. The problem was that the QCP example that we were given was for a different turbine manufacturer. Our component descriptions did not match that of the actual components, which we only found out when the drawings circa. 1962 were given to us. Our QCP was also drawn up where the NDT was required on components unseen as they were still in-situ in the turbine set that was still assembled. Additionally, most of us had zero experience in inspecting such equipment.

Some components had to be re-inspected as the incorrect method was initially specified. We often had to revise our inspection reports, as the component identification was usually incorrect. This occurred when the senior supervisor was asked to ensure that the components were labelled as per the drawings. He would usually delegate this task to an apprentice or assistant. Many an hour was wasted trying to decipher the person's handwriting on the tags as well as swopping the tags around when it was discovered that the components had been incorrectly marked, and the reports had to be revised too.

We had no access to any previous inspection records, so our brief was to 'record all indications'. This often led to some technicians recording gouges, scratches and other non-relevant indications. We were soon accused of recording 'fly crap' by our 'learned' colleagues from Europe who had been brought to SA to help and advise.

We learnt a lot about quality and the correct process selection – and thinking on your feet had to come into play. There was little time for indecision and procrastination. One had to be astute, especially where the age-old standoff between production and quality came to a head. This proved to be interesting when their cousin, Mr Safety, also had to be taken into account.

Particle testing (PT) on the piping inlets of an oil pump.

Some lessons

Proper planning, organisation, leadership and control must all be well established. A full breakdown of activities should be devised well before a shutdown/outage begins where everyone is fully informed and clear about the task and its objectives.

The NDT activities should also involve all paperwork including records, data capturing and reporting. The 'Management of Change' process should be an underlying principle that keeps everyone 'in the loop'.

A line of leadership or command should also be established and made known to everyone, as this helps especially at the early stages of a project.

Respect for other 'trades' should be a top priority as everyone has a job to do and no one should be made to feel inferior.

I have no doubt that many of these lessons are now been widely adopted and are routinely implemented during modern day inspections.

ESAB expands regional support

African Fusion talks to ESAB's regional product support team: Keith Saunders, who is responsible for standard equipment, automation and engineering; Brett Cameron, process specialist responsible for welding consumables and manual plasma systems; and Eugene van Dyk for mechanised CNC Cutting Systems, manual gas equipment, PPE and accessories.

Last year, ESAB began channelling the distribution of its welding range in South Africa through Colfax sister company, Howden Donkin. "To further simplify the regional support functions for the SADC region, ESAB has done away with country managers and decided to support its welding product range directly using its three product managers, with additional assistance from Dubai," begins Saunders.

"Between Brett, Eugene and I, who are all directly employed by ESAB Middle East and Africa, we will continue to support the regional market, which is predominantly in South Africa. For all ESAB distributors and direct customers, we will be responsible for product marketing and service support," he explains.

"We report to and are supported by ESAB Middle East, with Howden Donkin continuing to house us and to facilitate the warehousing and distribution side," he says adding, "so nothing has changed with respect to ESAB products being available for distribution and support across South Africa and into neighbouring southern African countries," Saunders assures.

The consumables specialist

Process specialist, Brett Cameron, continues: "Regionally, we remain very strong in submerged-arc welding, with the likes of our ESAB OK Autrod 12.22 wire with our OK10.72 flux being widely adopted.

"Our strength in submerged-arc welding has led to us dominate the wind tower manufacturing market in South Africa and, although tower manufacturing has been stalled recently due to delays in signing off the new REIPPPP projects, we are seeing a significant pick up in the Western Cape."

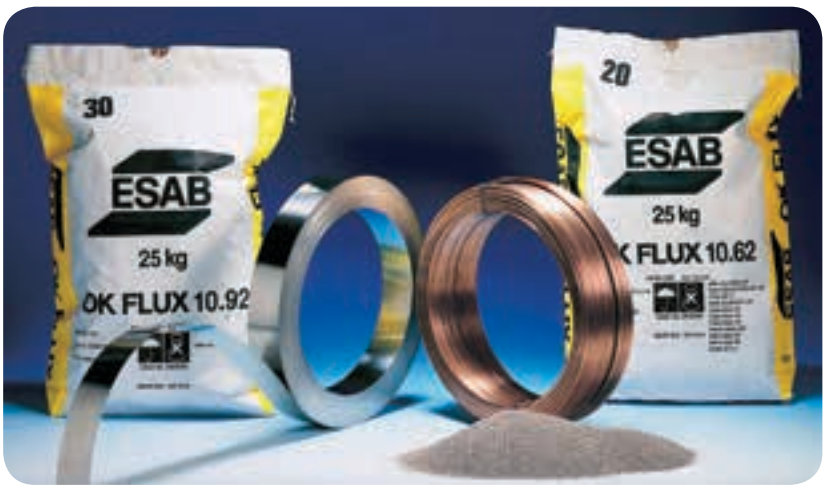
One of ESAB's bestselling welding consumable is the ESAB OK 55.00 manual stick-welding electrode. This is a premium, high-quality, low hydrogen and low moisture absorption (LMA) electrode, particularly suitable for welding high strength, low-alloy steels. It offers good low-temperature impact strength and is very resistant to hot cracking.

"On the GMAW process our OK Aristo

Rod 12.50 is a flagship consumable. This is a copper-free Mn-Si-alloyed solid wire for general construction, automotive components, pressure vessel fabrication and shipbuilding," Cameron says.

This wire incorporates ESAB's Advanced Surface Characteristics (ASC) technology, which enhances feeding performance, reduces spatter levels and increases efficiency, making it ideal for robotic and mechanised welding. "OK Aristo Rod 12.50 wire is routinely used on robot systems such as those at Transnet in Bloemfontein, which uses the 250 kg ESAB Marathon Pac™ to reduce handling costs," he adds.

"We now also offer a Tier 2 consumable range for those needing to squeeze costs," he continues. "These products, although less expensive, are all manufactured in ESAB factories to comply with all applicable welding consumable standards," he assures. Most notably,



Regionally, ESAB is strong in submerged-arc welding, with the likes of its ESAB OK Autrod 12.22 wire and OK 10.62, OK 10.72 and OK 10.92 fluxes being widely adopted.

For the mechanised CNC cutting side, large-format profile cutting systems connected to laser, plasma, oxy-fuel or waterjet (HydroCut) cutting systems and any combination of these are available.

ESAB's new REBEL will soon be accompanied by a dedicated 300 A TIG welder called the Renegade ES300i.

Cameron lifts out the ESAB WELD 70S-6 GMAW wire and the ESAB WELD 6013 general purpose rutile electrode as: "high-end Tier 2 consumables that are cost effective without sacrificing quality and performance".

ESAB is in the process of releasing a newly developed flux-cored wire, which will meet the high-level specification required for the doorframes of wind towers. "Our R&D facility is currently finalising the approvals for the consumable and we expect it to be made available soon," Cameron says.

Standard welding and automation equipment

Keith Saunders looks after the standard welding equipment and machines: ESAB's automation systems – column and boom systems, rotators and manipulators – along with custom engineered solutions such as its pull-through beam and profile welding systems.

"I handle the bread and butter MIG, TIG and stick welding machines along with our semi-automatic A2 and A6 submerged-arc systems, and units such as the flexible but simple MechTrac beam welding machine, which is equipped with A2 or A6 welding equipment for SAW," Saunders explains.

ESAB has also recently launched the "little REBEL", which is "the perfect machine for mobile and field applications". Compact and portable, the high-end REBEL 215ic has full multi-process capabilities and is ideal for stick welding with the more difficult electrodes, solid-wire GMAW and flux-cored wire welding or TIG welding in farming, construction, maintenance/repair and mechanical contracting applications.

"It will soon be accompanied by a dedicated 300 A TIG welder called the Renegade ES300i, a 15 kg mobile unit that has the highest power to weight ratio in its class," Saunders tells *African Fusion*.

His outlook for the welding industry? "Things are picking up," he responds. We are getting a significant number of enquiries from National Government-owned companies as well as heavy local equipment manufacturers. More exciting than the number of enquiries, though, is the size of the individual enquiries. Industry definitely seems to be preparing for an upswing."

Mechanised CNC cutting systems and gas equipment

"I am responsible for the mechanised CNC cutting side, large-format profile cutting systems connected to laser, plasma, oxy-fuel or waterjet (HydroCut) cutting systems and any combination of these," says Van Dyk, who is also ESAB's regional product manager for gas equipment, PPE and accessories.

"We also offer new-technology fibre-laser machines, which are a little more expensive than traditional CO_2 lasers, but they offer significantly cheaper costs per cut," he says, adding that ESAB concentrates on large format lasers, that is table widths of 4.0 m in lengths of between 8.0 and 20 m.

In the lower cost CNC space, ESAB has recently introduced the new A-series. "The A120, for example, is an automated version of the CutMaster. It can be coupled with any CNC table, either as a retrofit or to the low cost systems being custom built by local manufacturers," Van Dyk says.

ESAB is also the owner of the Victor Technologies gas equipment brands. "The Victor® EDGE™ 2.0 heavy-duty gas regulator recently won an iF Design Award in the Product - Industry/Skilled Trades category. iF International is Germany's oldest independent design organisation and has been highlighting the best in design all over the world since 1953. So this is a real honour for us," he tells *African Fusion*.

Durable and compact, EDGE series regulators have easy to read gauges with enhanced graphics, colour coded knobs for quick gas identification and offer more natural and safer hand/body positioning for adjusting delivery pressure.

The expanding service offering

In order to further the support for all ESAB equipment in the region, the company's service division through ESAB SA is currently being expanded.

Together with expanding the current service centre at Howden Donkin's Booysens premises, service divisions in Durban, Port Elizabeth and Cape Town are being established. "All new ESAB serviced centres and will be staffed with qualified technicians and mobile units to enable both site- and workshop-based equipment repairs," says Saunders.

"We are determined to improve spare parts availability and reaction times to break downs we will also be introducing SLA contracts. ESAB is committed to this region, expanding and here to stay," he concludes.

G-Plant CSI fund success

Air Products celebrates the completion of projects at Seeiso Primary, Lebohang Secondary and Bophelong Primary schools.

Air Products created a special 'G-Plant CSI Fund' when they launched the 'G-Plant' at their facility in Vanderbijlpark in 2014 with the aim of supporting upliftment projects at schools in the area. Projects have now been completed at Seeiso Primary, Lebohang Secondary and Bophelong Primary schools. This time, the unveiling is far from an industrial project but rather a much needed school hall, kitchen and enclosed assembly area.

The R800-million 'G-Plant' formed part of an investment pipeline of just under R2-billion and Air Products appealed to suppliers who worked on the project to make a donation towards this special 'G-Plant CSI Fund'. The main purpose of the fund was to facilitate better education for learners in the community. With the overwhelming support from suppliers, a total amount of R3.8-million was accumulated to develop and support schools in the area.

Air Products' strategic corporate social investment (CSI) main focus is on youth and education in South Africa and this project highlights the company's commitment to make a difference in the lives of the learners in the area.

The Department of Education played an important role in identifying schools in the Vanderbijlpark community that could benefit from this infrastructure project. Once the three schools were identified, an assessment was done of the needs and the building projects commenced.

Seeiso Primary School indicated that they needed a kitchen that could be used for the preparation of meals for the learners who are supported by the school's feeding scheme. Air Products built this kitchen and further created a water fountain for the children to have access to clean drinking water at the school during the day.

Lebohang Secondary School's request was to enclose the area that they use for assembly and other meetings. A solid roof structure was built to provide shelter for the learners and educators during different weather conditions.

Lastly, Bophelong Primary School had suitable space to build a school hall, one that has been received with much gratitude.

Unveiling Bophelong Primary School Hall on February 2, 2017 are, from left: Mr Sebeho, Department of Education; Mr Smit, Bophelong Primary School; and Mr Rob Richardson, Air Products.

Rob Richardson, managing director at Air Products comments at the unveiling ceremony: "The upliftment projects at these three schools would not have been possible without the support of the suppliers who contributed to this 'G-Plant CSI Fund'. We are extremely grateful to the companies who decided to join hands with Air Products to make a difference."

According to Richardson, these projects are the organisation's way of giving back to the community in which they operate. The facility in Vanderbijlpark was established in 1971 and he thanked the community for welcoming them into their community and allowing Air Products to make lasting improvements to the infrastructure of the schools.

Air Products has a number of CSI projects that it supports each year. Firstly, an annual allocation is made to each supported facility across the country, with key CSI role players at each of the facilities identifying projects in need of funding. There are also national projects and annual donations to organisations with whom Air Products has built a long-term relationship over the years.

Last year with the launch of the 3-year national 'Witness Happiness' project, Air Products once again focused on the strategy and committed to education. This project is purely focused on Early Childhood Development (ECD) Centres.

Richardson concludes: "Investing in education and the youth in South Africa is our way to uplift and ultimately create a strong economy for the future, one in which we aim to provide an opportunity for each and every child to excel as an adult." ***www.airproductsafrica.co.za***

Air Products makes history at Noschcon

Air Products exceeded their previous records when they walked away with ten Noscars at the 2016 Noschcon awards last year. As an organisation that is known and respected for their safety track record, the company remains determined to build on this success.

Seven of the Air Products sites, including Cape Town, Port Elizabeth, Pinetown, Empangeni, Witbank, Newcastle and Springs, received Noscars for continuing to meet the stringent criteria in their last NOSA audits and the overall sector winner, the Kempton Park facility, was also awarded a Noscar.

Sue Nicholls: Corporate Group Risk Manager of the Year, 2016 at the Noshcon Awards with Justin Hobday (L) and Duncan Carlisle(R) from NOSA.

In addition, two Air Products employees received individual awards: Sue Nicholls was Corporate Group Risk Manager of the Year, while Rushda Thomas was chosen as the Environmental Coordinator of the Year.

"Air Products has established a culture with a strong emphasis on health and safety and we appreciate the recognition that we receive for our consistent commitment to safety at the company's nationwide facilities," says Nicholls.

"As a leader in the industrial gas industry, Air Products' safety, health and environmental vision is to be a leader in protecting the environment, health and safety of all our employees, customers and the communities in which they operate. In order to make this vision a reality, there is continuous improvement of the safety, health and environmental management system throughout the organisation," she adds.

FlexArc: a new generation welding cell

Optimal productivity requires welding equipment that combines effective operation with maximum cost-efficiency. Modular and modern standardised robot cells such as ABB's FlexArc® are an established way of raising quality and productivity standards.

ABB's new-generation FlexArc® robotic welding cells are complete robot systems available in several flexible and versatile standard modular packages.

FlexArc® welding cells are designed to deliver cost-effective, state of-the-art robotic welding operations. All cells deliver maximum performance whilst making optimum use of available space. The basic cell options feature a single or two robots with Multi-Move, a choice of ABB positioners from an extensive range and welding equipment to suit the needs of the application.

All equipment is installed on a common movable platform, which provides for easy relocation within the production facilities. The cells are also equipped with centralised power distribution – all of the connected equipment such as robots, positioners, welding machines, lighting and other peripheral devices are supplied from a single power connection, which means that only one supply cable for the whole cell is necessary.

Advantages of adopting ABB's FlexArc welding cells include:

- Low investment costs.
- An intuitive graphical user interface for operators.
- Reduced downtime thanks to improved error handling.
- Higher quality through automatic production and process monitoring.
- Improved cost-efficiency thanks to global standardisation.
- Short delivery times.
- Proven two-station principle – loading and welding.
- Off-line programming for fast and easy implementation.
- Improved workspace safety.
- Boosts workflow.

FlexArc features the FlexPendant graphical user interface, which not only provides operators with an overview of the status of the cell, it also records and displays important quality and production data. The interface allows the operator to communicate effectively with all of the functions within a cell and to access all information regarding cell performance, including the status of the robot and controller along with other functions such as controlling the roll-down doors.

With minimal training, the user can organise welding operations into a series of process steps. The operator has all the information necessary to keep track of the number of parts produced, cycle times, the number of welds completed and the lengths of individual welds.

Easy implementation makes the FlexArc's standard approach the natural choice for plug-and-produce operations.

In general industry the system is ideal for fabricating door modules, grids, switchboards, printing units, steel furniture, shopping carts, racks, compressors, lawnmowers, two wheelers and construction and agricultural equipment components.

In the automotive industry; cross members, engine cradles, door modules, exhaust systems, brake components, car seats, wheels, axles and dash boards can all be successfully manufactured using a FlexArc cell.

Virtual FlexArc: the ultimate productivity tool

A virtual replica of each FlexArc cell is available free from the ABB robotics website. This enables operators to be trained in the virtual world, in advance, obviating the need to lose valuable production time due to training on the real system.

The virtual cell can be used to generate specific part welding programs off-line before the new system arrives, enabling production to hit the ground running as soon as installation is complete. It also enables weld fixture to be designed and optimised without needing direct access to the welding cell itself. This allows tool and weld torch access along a weld seam to be verified in advance, prior to manufacturing clamping and fixture tools.

Tools to raise quality and increased uptime

ABB's patented BullsEye® allows accurate definition and automatic updating of the tool centre point (TCP) and the torch angle. BullsEye operates in two modes: Set up mode, to define a new tool in the system; and Quick check, a periodic tool checking routine. The frequency of checking is specified within the program and automatically updated when a deviation is found. These checks/updates result in an improvement in the quality of welded parts and a significant increase in productivity of the cell.

TCP continuously establishes reference points for the welding wire so that it always contacts the workpiece accurately along all points of the programmed weld path.

The robot system incorporates production monitoring to automatically monitor weld lengths and the number of welds made on a component. Reports, screen messages and warning lights are displayed if a part is not being produced according to the original specification. This enables the operator to take immediate action to repair or reject a faulty component.

ABB's Navigator technology includes cell calibration for off-line generated programs, tooling calibration – including integrated coordinated measurement functionality – and cell self-diagnostics.

In addition, thanks to Integrated Error Resolution, there is no need to enter the cell when a weld error occurs. At the push of a button the robot will go to the service pocket in the guard, where the operator can service the welding gun, change the contact tip, etc. This saves valuable production time and results in increased productivity.

Safety still a priority after 90 years

Despite increasing legal pressure to ensure workplace safety, unsafe gas and electrical arc equipment continues to find its way into industry. This presents a legal risk to companies and a risk to the safety of their employees. As sub-Saharan Africa's market leader in gases and welding products since 1927, Afrox continues to place utmost priority on safety and continuously strives to improve workplace safety at its customers' sites through the company's Safety Solutions Programme.

Afrox's industrial gas equipment is manufactured to the highest standards with all cutting torches conforming to ISO 5172.

Afrox's Safety Solutions Programme was launched in 2005 to assist customers at management level and their SHEQ personnel in meeting legal requirements. This end-to-end solution begins with a detailed scope of work identifying all applications at customers' sites, detailed onsite safety audits to identify unsafe practices in the workplace, and identifying gaps in compliance with the OSH Act and ISO specifications.

After completion of a safety audit, Afrox will provide the customer with a detailed risk assessment and process/application recommendation report. Afrox is also able to assist with reviewing customers' standard operating procedures to identify gaps and to upgrade information conforming to all standards and legislation, a service that Afrox highly recommends to ensure workplace safety.

As part of the Safety Solutions Programme, Afrox offers safety training at customers' sites. Training material includes modules on the safe use of gas and gas equipment, the safe use of electrical arc equipment, as well as modules on special and other industrial gases.

After training is completed, delegates will undergo a theoretical or practical assessment and will be issued with a certificate that is valid for 2 years. Afrox trainers are CHEITA accredited facilitators, assessors and moderators and have trained over 13 000 delegates in the mining, transport, fabrication, petrochemical and energy sectors.

"We care about our customers and are committed to delivering on our promise of safe quality products," says Hennie van Rhyn, application development manager at Afrox. "Afrox's industrial gas equipment is manufactured to the highest standards. Our regulators are manufactured according to Afrox specifications and are ISO 2503 certified. Our flashback arrestors conform to SANS/ISO 50730-1, gas hoses to ISO 3821 and 1156-2, and cutting torches to ISO 5172," says van Rhyn. ***www.afrox.co.za***

New NDT manager for Skyriders Mpumalanga

Leading rope-access specialist Skyriders has appointed Gerhard Kemp as the non-destructive testing (NDT) manager at its eMalahleni branch in Mpumalanga, tasked with overseeing the NDT/inspection division.

Kemp has an NDT qualification from the South African Institute of Welding (SAIW), where he completed modules in magnetic particle inspection (MPI), penetrant testing (PT), ultrasonic testing (PT) and radiographic testing (RT).

He is also accredited in terms of Welding Inspections PCN Level 1 from the African NDT Centre. Kemp's experience has been gained on BS EN (British European) and AWS (American Welding Society) standards for NDT.

Kemp commenced his career in 2002 as an NDT assistant, progressing to site supervisor and site manager at Eskom's Tutuka Power Station, and then site manager at Kusile Power Station. He has worked in a range of industrial sectors, from power generation to mining, steel, chemical plants, paper mills, and cement and sugar factories.

His role as NDT manager at Skyriders is focused on constantly upgrading and expanding the company's inspection service offering. Kemp is also involved in training Skyriders personnel to become multi-skilled in various NDT methods, researching the latest developments and technology, and maintaining and sourcing new client relationships.

Skyriders, established in 1998, is a leader in the South African rope access industry, providing cost- and time-saving solutions to clients in the power generation and petrochemical industries that require rope access aided inspection, NDT and maintenance work to be done in difficult to reach, high-up locations. ***www.ropeaccess.co.za***

Internship programme upskills engineers

Upskilling the engineers of tomorrow is the main aim of an internship programme offered by Rio-Carb, a leading manufacturer of R-C700 CrC wear liners and pipes for heavy materials-handling applications in the mining and allied resources industries.

University of the Witwatersrand (Wits) BSc Mechanical Engineering student Uma Krige has just completed a six-week internship programme at the Alberton manufacturer. "Our aim is to make a meaningful contribution to the development of the industry by upskilling the engineers of tomorrow," says director Martin Maine.

Top achiever Krige impressed Rio-Carb due to her notable academic achievements to date and leadership qualities. The six-week internship gave her invaluable exposure to both production and business processes, in the company of experienced engineers.

"Rio-Carb is essentially a one-stop shop where interns can learn everything from CAD design to actual engineering production. This is a hands-on, real-life learning environment that gives tertiary students much-needed practical experience," Maine explains.

Krige stresses that the exposure to a broad-ranging production environment such as at Rio-Carb is rounding her theoretical training at Wits. Apart from being able to see processes such as plasma cutting, welding, grinding, drilling, and sheet-forming first-hand in a highly-automated and bespoke facility, she has also attended client site visits, and even sat in on sales and production meetings.

www.riocarb.co.za

Welding screens' edge on safety

The patented Balledge® design used on Apex Welding and Safety Screens is a major advantage as this aids access into cordoned off areas for workers without snagging or scratching, increasing safety in the workplace.

Wim Dessing, managing director of Apex Strip Curtains, explains that the reinforced edge on the individual strips allows the strips to part easily, facilitating easy access for both personnel and equipment.

Locally manufactured Apex Welding and Safety Screens have contributed significantly to improved safety in many manufacturing facilities in southern Africa. The innovative PVC screening material is used to cordon off welding and grinding bays.

Made from specially formulated material, which incorporates a heavy duty ultra violet light absorber, the Apex Welding and Safety Screens give end users assurance that dangerous UV radiation is safely contained in the curtained off area. This protects workers in close vicinity to welding and grinding activities.

Extensive tests conducted by the SABS proved the Apex Welding and Safety Screen material is superior to conventional material used for these products.

Tested for ultra-violet transmittance, the conventional material gave readings of 0,005%, 0,008% and 5.0% as opposed to the Apex readings of 0,005%, 0,001% and 0,005%. When tested for total visible light transmittance, the tests were conclusive – the conventional material allowed 78 % through while the Apex material allowed only 15.5 % light transmittance.

Apex Welding and Safety Screens are impervious to burning, which is of particular importance should the material come into contact with welding spatter.

Available in several configurations to suit individual applications, the most popular version is the free-standing frame that facilitates both easy handling and portability. The screens' angled feet allow optimum utilisation of the floor space as the screens can be butted together at 90 degree angles.

www.apexstrip.co.za

Locally manufactured Apex Welding and Safety Screens have contributed significantly to improved safety in many manufacturing facilities in southern Africa.

Castolin Eutectic launches portable machines

In January 2017, Castolin Eutectic launched three next-generation MMA and manual TIG welding machines: the ACCUmax, a new portable power source running on high capacity lithium-ion batteries; the POWERmax 4.0, a 150 A machine; and the POWERmax 1800, an alternative 180 A constant current power source.

Cable-less mobile welding on top of mountains, in difficult-to-access areas, in farming land or construction sites is now possible owing to AccuMax, the lightweight small MMA welding machine that does not require mains electricity. With a fully charged battery, welding jobs can be autonomously performed for up to six electrodes of 3.25 mm diameter and up to 18 electrodes of 2.5 mm in diameter.

ACCUmax is also suitable for welding in electrically hazardous areas, such as in-situ boiler welding, container construction and shipbuilding. The fast-charging mode allows the battery to fully charge in 30 minutes, while the normal charge for maximised equipment autonomy needs 45 minutes. In the case of long duration welding repairs, a 2.0 kW generator is enough to power the unit, which avoids the need for expensive generator investments.

With reduced weight and compact size for versatile on-site handling, PowerMax 4.0 makes welding easier via an innovative resonance principle: the quick reacting characteristic curve of the unit means welding performance is improved even with demanding manual electrodes. The digital resonance inverter ensures an extremely stable arc, as well as reduced spatter formation.

In addition, by adapting the power consumption to the network voltage, the losses due to inductive and capacitive reactance effects are reduced and the energy-efficiency improved.

Power factor correction enables energy savings and the use of extended mains cables of up to approximately 100 m, as well as a more flexible input voltage range.

With AccuMax and the new PowerMax, welding has entered the smart 4.0 era.

Castolin was founded in Lausanne, Switzerland in 1906 by Jean-Pierre Wasserman, who developed a way of brazing cast iron at low temperatures.

AccuMax is a small, lightweight MMA welding machine that does not require mains electricity.

Eutectic Welding Alloys was formed in the 1940s and over the years, Castolin Eutectic became a worldwide leader in welding, brazing and thermal spray technologies, offering maintenance, repair and wear protection solutions.

Castolin Eutectic became part of the Messer Group in 2005 and, in South Africa, its products and services are available through Messer Eutectic SA.

www.messer-cs.co.za

CMT upgrade for robotics power source

The newly developed Robacta Drive CMT TPS/i push-pull welding torch boasts compact dimensions and low weight. Images courtesy of Fronius International

Fronius is expanding the range of functions of its intelligent TPS/i Robotics power source. This system, which is specially designed for the requirements of robotic welding, can now be equipped with the extremely stable cold metal transfer (CMT) welding process using a new additional package. Users benefit from the combination of an extremely high and reproducible weld seam quality, maximum welding speeds and countless areas of application.

Fronius is expanding the TPS/i Robotics power source with a new additional package for the stable cold metal transfer (CMT) welding process.

With TPS/i CMT Robotics, Fronius combines the advantages of its latest MIG/MAG power source platform with the most stable arc. The intelligent, modular system consists of interconnected and fully synchronised components and is specially designed to meet the demands of robot-assisted welding. The TPS/i power source has a high-performance processor and a high-speed bus, enabling data to be exchanged extremely quickly. This results in control loops that are faster than before.

Two perfectly synchronised wirefeeders ensure dynamic and precise wirefeeding and thus high process stability. What's more, the newly developed Robacta Drive CMT TPS/i push-pull welding torch impresses with its compact dimensions, which enable easy access to the weldments and low weight for use on robots with high traverse speeds.

TPS/i power sources that already have the Standard and Pulse function packages installed can easily be upgraded for the CMT process. In comparison with other MIG/MAG welding processes, CMT significantly reduces the heat input and enables continuous regulation from cold to hot. This results in an extremely stable arc and much less spatter even at high welding speeds.

It can be used for a wide variety of different applications, including welding light and medium-gauge sheets from 0.5 to 4.0 mm, root passes, galvanised steel and special connections such as copper, zinc, steel-to-aluminium and titanium.

With TPS/i CMT Robotics, robot-assisted welding operations can be performed cost-effectively, efficiently and to a high standard.

Supporting welding education and training in South Africa

Lincoln Electric, a global pioneer of welder training resources and programmes, is to host a training seminar at its Lincoln Electric Weld Technology Centre in Midrand on the May 9 and 10, 2017.

Presentations and practical demonstrations will be used to highlight:

- The QCTO and IIW Welder training curricula and qualifications.
- Virtual welding solutions.
- The additional advantages of Lincoln's new Realweld training system.
- Fume extraction and welding school safety.

Speakers include: Etienne Nell from the SAIW, who is also the South African welding expert for the WorldSkills competition; Louis Uys of Airtrax, the local specialist installer of welder training facilities and fume extraction systems; and members of the local Lincoln Electric technical team.

The key objective of the seminar is to address South Africa's welding skills challenges by introducing welder training enhancement solutions and to highlight the availability of internationally recognised and effective training curricula, tools and equipment.

This seminar is a must attend function for welding training school managers and trainers; TVET colleges, managers, teachers and technicians; welding training and workshop managers; and persons responsible for welding personnel in industry.

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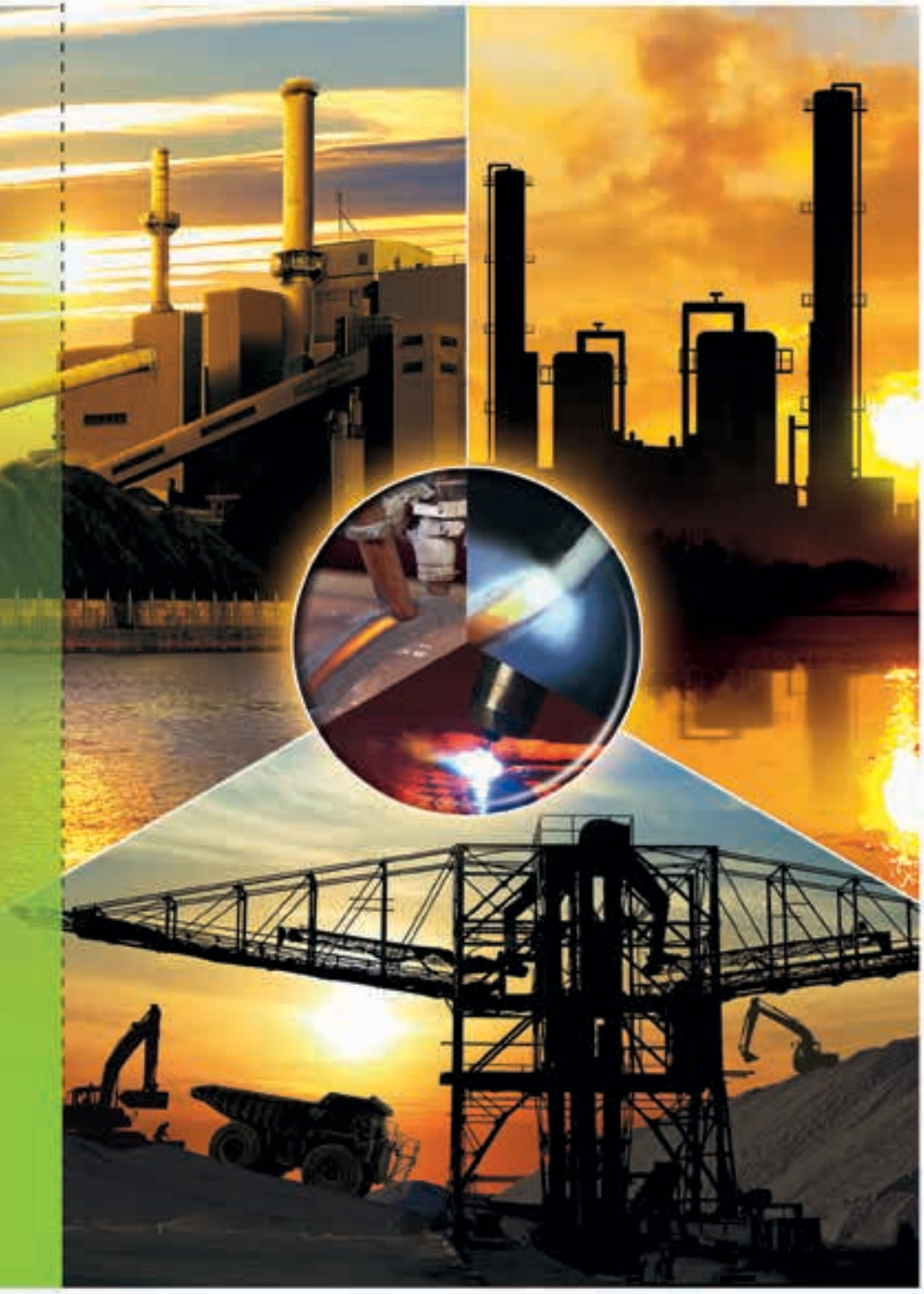

Oerlikon offers high-quality products and services related to welding operations in the energy sectors

A full range of high performance consumables for highly demanding welding applications: MMA-electrodes, MIG/MAG cored and solid wires, TIG rods, submerged arc wire or strip/flux combinations.

To know more ask for the specific brochures *(Mines & Quarries - Thermal Power Plants - Petrochemicals - Wind Energy - Offshore - Pipe laying - Pipe Mills)* on **www.oerlikon-welding.com**.

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