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SAIW

MARCH 2020

Journal of the Southern African Institute of Welding

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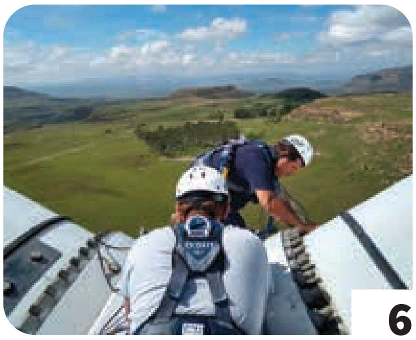
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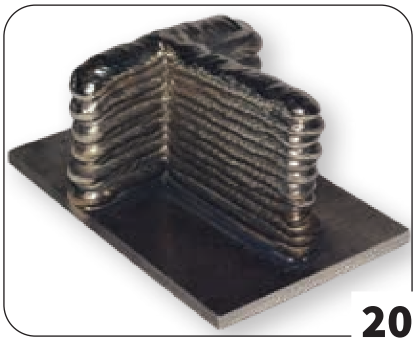
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Join the SAIW today and enjoy significant discounts for corporate members on training and certification costs; free access to CPD webinars and discounts on seminars; listing and access to SAIW certified welders database and more. For only R6 400 a year (corporate members) or R820 a year (individual members), you too can benefit from SAIW membership.
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SAIW
Southern African Institute of Welding

Our country and its metals fabrication industry are, undoubtedly, in the midst of very harsh economic times right now, and the SAIW is far from immune. Many of our supporting member companies and users of SAIW services are having to cut costs by shortening working hours, retrenching staff and setting annual pay increment of 0%.

Delivering his 2020 Budget speech during the last week of February, Tito Mboweni opened by referencing one of Southern Africa's indigenous plant species, the Aloe Ferox, which is widely used to make medication and cosmetics. "The Aloe Ferox survives and thrives when times are tough," said Mboweni. "It actually prefers less water. It wins even when it seems the odds are against it."

I cannot say that we at the SAIW prefer "less water", but we know we have to respond to tough times with realistic plans to ensure we grow our revenues and cut costs so that, like the Aloe Ferox, we survive and are still around to benefit when the upturn comes. "Our Aloe Ferox can withstand the long dry season because it is unsentimental. It sheds dead weight in order to direct increasingly scarce resources to what is young and vital," said Mboweni in his address.

With respect to the budget, we applaud the principles underpinning much of Mboweni's plans. Strengthening the macroeconomic framework; delivering certainty and transparency and lowering borrowing costs; focusing spending on education; modernising our state-owned enterprises; opening markets to trade with the rest of the continent; reimagining our industrial strategy and lowering the cost of doing business are all worthy goals. It is easy to envision a successful 'jump-start' in these areas as having a significant positive impact on the economy.

In particular, we look forward to seeing benefits for our industry from the Development Bank of Southern Africa's R200-billion Infrastructure Fund for packaged mega-projects. We are also at one with our Minister of Finance with respect to the need to raise skills and, more importantly, to improve "the matching of young people and jobs", as is evident from the time, effort and energy we have put into our pilot QCTO apprenticeship.

Also on the training side, we are currently seeing exciting things in our work in Africa. Uganda and Ethiopia, for example, are currently looking to partner with the SAIW to develop local welding training initiatives to service their local fabrication industries. Our training manager, Shelton Zichawo, has just returned from a trip to Addis Ababa in Ethiopia, where he was asked to assist in setting up the National Welding Training Institute (NWTI). Ethiopia has seen the need to improve the competitiveness of its local manufacturing industries and sees the NWTI as a way of providing them with internationally certified welders.

The SAIW has an important role to play in Africa and we are starting to work with the dti as a key enabler of industrialisation through 'train the trainer' welder training, while also establishing ATBs in several African countries North of our borders.

We also have the capacity to provide training for welding support services, such as Welding Inspectors and NDT technicians, to further capacitate the metal fabrication industries in those countries. To present this offering, we will be joining the dti on the upcoming National Pavilion in Rwanda and will also apply to participate in selected business-to-business missions in the coming months.

We see the most important role of the SAIW as nurturing its membership so that, like the Aloe Ferox, the fabrication industry can become more resilient, sustainable and able to thrive for the benefit of all South Africans.

John Tarboton

World-class excellence with members at the forefront

African Fusion talks to SAIW executive director John Tarboton and business development manager Etienne Nell about their vison for a renewed SAIW where members are at its centre and their needs drive SAIW's evolving service offering.

"In revitalising the SAIW, the starting point, I believe, has got to be our Memorandum of Incorporation (MOI). First off, we are an NPC, a non-profit company, not a traditional business. In terms of 'gain', NPCs are incorporated to deliver particular services for the benefit of a specific group of people: in our case, SAIW company/corporate members and welding industry professionals who join the Institute as personal members," begins Tarboton.

"Simply put, everything we do must benefit our membership," he says.

From this starting point, Tarboton reveals that the SAIW has developed a new value proposition: "The SAIW empowers members to improve productivity and quality while reducing rework and costs for all welding related manufacturing activity – and we do that through training and qualifications; certification of companies and personnel; and technology transfer," he says.

Tarboton believes that engaged members are more likely to utilise the multiple service offerings of the SAIW: the training courses; the laboratory; technical and consultancy; and qualification and certification services; and many more. "But it is important to make sure we are delivering the services our members want us to, rather than just promoting what we have. We have therefore started a process of engaging with existing and previous members, as well as our ISO 3834 certified company members, to find out how we can better meet their current and future needs," he continues.

"We have identified four service areas of direct benefit to our membership, services that we believe all contribute towards our vision: to promote world-class excellence in welding, NDT and allied technologies; and our broader Mission: the development and upliftment of the national welding capability," Tarboton tells *African Fusion*: These four areas are: training; technology; certification; and member marketing.

Etienne Nell, SAIW's welder training stalwart, has been appointed to lead the member engagement initiative by taking the Institute's new approach to members. "Etienne's role has now been refocused onto servicing and recruiting members, identifying new and future services that might meet their needs, and making sure that members know how we can help them," Tarboton explains.

"In recent weeks, I have been visiting our ISO 3834 clients, finding out what they are doing and which additional SAIW services they may like to take advantage of," continues Nell. With training as the starting point – skills development training and personnel qualification courses – Nell says that the Institute offers welding, inspection and NDT training courses to internationally approved standards, much of which is required to remain certified to ISO 3834. "We are now guaranteeing a 7.5% discount for SAIW company or personal members wishing to take advantages of any of the Institute's training offerings. This discount can make a big difference in training costs to a company, particularly if sending several of its people on courses to fulfil different contract requirement," he adds.

On the technology side, the SAIW strives to give members access to high level advice: through seminars by world leading specialists, for example, "and we are going to be delivering monthly webinars, too, which we see as contributing to the accumulation of professional development points (CPD) for those who need them. These will be free to members, who will simply log in at the appropriate time to access the session," adds Tarboton.

Nell continues: "There is also a long list of the technology services we can offer to support the welding and inspection needs of our members: Discounts on laboratory, technical and consultancy services; free telephonic consulting and code interpretations; free independent third party NDT report reviews; free access to the SAIW library and its collection of read-only standards; and much more."

Certification forms the third leg of the renewed member offering and the SAIW is offering company members a 5% discount on certifications and re-certifications such as ISO 3834, and all personal members will be entitled to a 5% discount on professional certifications and recertifications, for example.

In addition, members needing to

The SAIW is encouraging members to use its state-of-the-art facilities for customer open days and technical seminars, at significantly discounted rates.

maintain their professional status, such as SAQCC CP and IPE personnel, can benefit from free remote CPD points, Authorised Training Bodies (ATBs) will be offered free initial marketing audits on application, while initial ISO 3834 marketing audits will also be free.

"Then we have the fourth leg, which is on the marketing side, where we aim to promote the capabilities of our members to the broader industry, nationally and internationally," Nell informs *African Fusion*. "Being a member of the Institute means something with regard to credibility and we are encouraging members to take advantage: by using our 'Member of SAIW' logo for example, or by taking advantage of MSAIW branding for personal professional recognition."

"All SAIW members are eligible for AGM voting rights and board membership as well as discounts on advertising rates in our journal, *African Fusion*. We are also encouraging members to use our state-of-the-art facilities for customer open days and technical seminars at significantly discounted rates, and we want to share and publish far more member success stories and welding case studies," adds Tarboton.

The member databases are also being strengthened and SAIW will keep a register of SAIW certified welders to allow free to access for corporate members for recruitment purposes. Free job advertisements are also available on the SAIW website.

"We want to encourage all welding professionals to register and join so that an employer can quickly and reliably vet their SAIW qualification status. And vice versa: we want welding personnel to prefer to work for SAIW member companies."

In the first two weeks of his member engagement task, Etienne Nell has seen 21 ISO 3834-companies that are on the SAIW Welding Fabricator Certification Scheme. "Many who are not members are now interested because of the additional benefits and discounts we offer. We are now much better able to define and even calculate the value of SAIW membership, in terms of savings for services that usually have to be costed into a project, anyway. Members not only benefit from a competitive advantage, they can also advance their status and credibility," Nell says.

"I am also talking to steel suppliers, who are part and parcel of our industry and can help their customers if they know how SAIW can help on the fabrication side. We are offering our facilities to these companies for sales meetings and/or client open days, for example, and we will add on a tour of our capabilities so sales teams are better informed when they visit fabrication sites.

The SAIW's state-of-the-art IIW-accredited welding training school in City West Johannesburg, where welders are trained according to internationally approved standards.

Tarboton adds: "This is about fostering wider collaboration across the industry. We are also talking to other industry associations, such as AFSA, SASSDA and SAISC, to see how we can help each other to deliver better support for all of our members. We aim to build strong alliances, which we believe is at the heart of making our Institutes and Associations, as well as the businesses of our members, more robust and sustainable."

"We are on a strong and determined drive for greater member involvement. For fabricators looking to reduce rework and improve productivity, we see partnering with the Institute and, together, seeking to improve our processes and performance, as the simplest path to long-term success.

Confidence Lekoane in the SAIW Materials Testing Laboratory: SAIW is offering member discounts on laboratory, technical and consultancy services; free telephonic consulting and code interpretations; free independent third party NDT report reviews; free access to the SAIW library and its collection of read-only standards; and much more.

"In addition, the success of our welding industry is highly dependent on the qualifications, skills, knowledge and dedication of its personnel. For any individual wishing to succeed in the industry, SAIW membership offers multiple pathways for networking, continuous professional development and career success," Tarboton concludes.

Hundreds of young South Africans have graduated from SAIW Inspection courses over the years with qualifications developed in conjunction with industry to ensure that industry's needs are being achieved.

Stanley Inspection SA: a blue ocean

This month's SAIW Member Profile comes from Stanley Inspection. *African Fusion* talks to Shaun Meerholz, the company's deputy general manager, about the company's modern inspection offering and the important role of inspection services in ensuring the integrity, safety, reliability and longevity of critical plant such as those in our power, petrochemical and mining industries.

Stanley Inspection is a worldwide leader in specialist inspection, non-destructive testing (NDT) and heat treatment services. The company provides a full range of modern services that can successfully take clients through design and engineering to resourcing, execution, long term maintenance and safe operation. Shown here is a team undertaking a phased-array lamination scan of the turbine blades of a wind turbine.

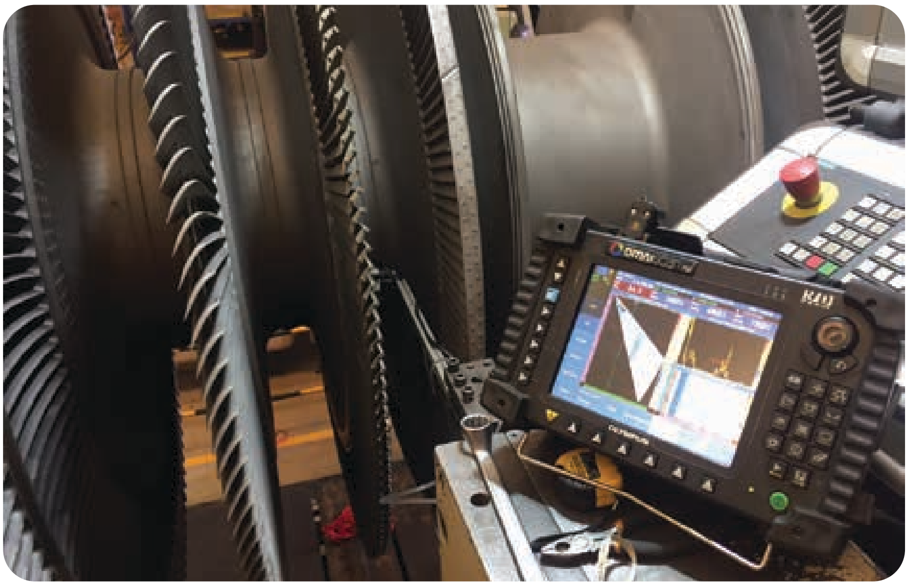
Stanley Inspection's history in South Africa has multiple strands. It first began back in 1978 during the construction of Sasol 2, which led to the incorporation of The Unit Inspection Company of South Africa in 1980. In 2007, Unit Inspection merged with another South African company, nuclear NDT specialist, De-Tect, which was itself founded by Yusef Patel in 1995. This merger formed one of the leading B-BBEE inspection specialists in Africa: De-Tect Unit Inspection.

A share in this company was then bought by CRC-Evans International, which was taken over by Stanley Black & Decker in 2018, which, in that same year, also bought industry leader, Sonartech CC, before adopting the current group name, Stanley Inspection South Africa (SISA).

Today, Stanley Inspection is a worldwide leader in specialist inspection, non-destructive testing (NDT) and heat treatment services. "We strive to provide a full range of modern services that can successfully take clients through design and engineering to resourcing, execution, long term maintenance and safe operation," Meerholz tells *African Fusion*.

The company has ISO 9001: 2000 certification and is a preferred supplier for major clients in South Africa's power generation, petrochemical and oil and gas industries including Sasol, Eskom, Chevron, Fluor, ArcellorMittal, Babcock and Rotek Engineering. "Also, as an international service provider, we have worked in Swaziland, Kenya, Sao Tome, Namibia, Ireland, Nigeria, Abu Dhabi, Brunei, Congo, Botswana, Cameroon, Mauritius, Seychelles, Turkey, the United Kingdom, and the United States," Meerholz says.

SISA has offices in Johannesburg, Richards Bay, Secunda, Vereeniging and Cape Town.



Stanley Inspection has developed phased-array techniques for use on complex geometries such as turbine blades and discs in situ, eliminating the need for costly removal and refitting.

SISA solutions

"We exist because we provide solutions to industry's current needs," Meerholz continues, adding that, "We can offer solutions and services that no other company can.

"Each of our services is delivered via a fully-qualified team that can come out to site to inspect the plant to ensure it can continue to operate safely, reliably and efficiently.

"Modern inspection requirements often demand complex investigative solutions from a qualified third-party. STANLEY Inspection engineering personnel work in conjunction with site-based project management teams to deliver innovative solutions using state-of-the-art inspection applications. Our proven expertise ensures integrity, safety, and efficiency throughout all phases of an operation and technicians are available for long and short-term project assignments as required," he says.

Areas of focus include piping, mechanical, electrical and overall project engineering – and SISA has expertise in almost all NDT techniques. Most notable among these are: compression, shear wave and wall thickness ultrasonic inspection; phased array, guided wave and time of flight (ToFD) ultrasonics – including TFM (total focus method); conventional x-ray and gamma ray radiography; computer/digital radiography (CT);

service provider

fluorescent and visible dye penetrant and magnetic particle inspection; IRIS and eddy current tube inspection; laser profilometry; and many more.

Over the past two years, depending on individual power station requirements, SISA has been actively developing advanced tube inspection and phased array inspection techniques for South Africa's power industry. "We pioneered smallbore phased-array UT inspection on boiler tube with wall thicknesses of 3.4 mm and up, comparing the results to traditional X-ray techniques. We have also developed phased-array techniques for use on complex geometries such as turbine blades and discs in situ, eliminating the need for costly removal and refitting," Meerholz informs *African Fusion*.

For the petrochemical industry, SISA has been active in the detection of high temperature hydrogen attack (HTHA), which occurs in refinery equipment exposed to hydrogen at temperatures above 200 °C. At high temperatures under dry conditions, hydrogen gas dissociates into atomic hydrogen, which can then diffuse into the steel structures of vessels. "Using advanced ToFD along with total focusing method (TFM) phased array equipment, we are able to detect tiny HTHA defects that indicate the onset of potentially catastrophic HTHA-induced failure," he explains.

On the nuclear side, Meerholz cites the company's involvement with the PTR tank refurbishment project at Koeberg. These tanks store borated water for the reactor cavity and spent fuel pit cooling system. This was the first nuclear PRT tanks replacement project in the world, and was recently completed using SAIW-trained UT technicians with nuclear site training enabling them to complete the contract successfully," he adds.

SISA has been collaborating with the SAIW with respect to training for many years. "We were one of the first inspection companies to work with the SAIW and, over the years, we must have sent over 200 people on SAIW NDT and Inspection courses. Our heat treatment specialist, James Kirwan, wrote the training syllabus in conjunction with the SAIW to supply industry with qualified Heat Treatment technicians.

An ultrasonic examination of the rotor bores of a turbine.

"Currently, we are collaborating with Mark Digby and Harold Jansen to develop a training course encompassing eddy current, IRIS (internal rotary inspection system) and remote field techniques to certify technicians to ISO 9712 for tube inspections," Meerholz relates, adding that the first of these courses is planned for May.

STANLEY Inspection SA is a preferred NDT inspection provider on outages and maintenance for six of Eskom's 15 power stations. "We are now also picking up work in African mines and in petrochemical and nuclear plants in the Middle East, for example. We are specialists in high temperature phased array inspections, which can be done while a plant is still online, that is, before a shutdown. This enables operators to better plan for required maintenance during a shutdown, and this can minimise downtime.

"We have also developed a CR digital radiography technique that enables us to do online corrosion and thickness testing without having to remove the insulation from pipes

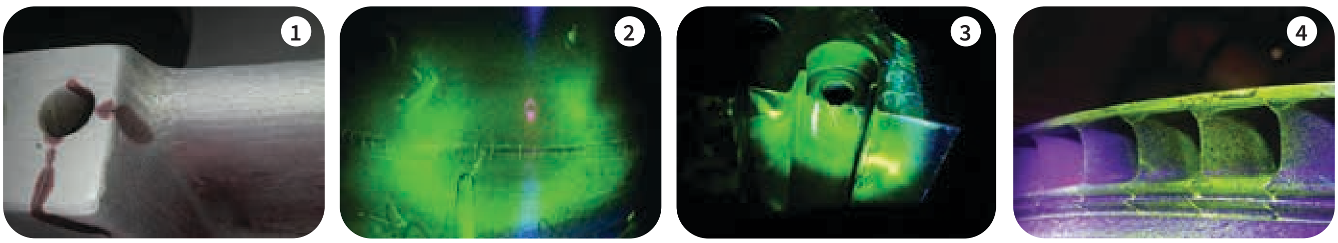
"Services such as ours are absolutely necessary, not only to ensure safe operation, but also for preventative maintenance. Big asset owners have routinely seen the cost-saving benefit. Our inspection work often prevents dangerously catastrophic and very expensive failures," he says, adding, "which, for the owner, is worth its weight in gold."

Turning attention to current developments, Meerholz says that, while SISA technicians understand data, the company is currently developing simpler and more user friendly NDT reporting packages to make it easier for engineers to understand results and their implications. "In collaboration with some US companies, we are working on a very visual reporting package that will help maintenance professionals to quickly assess the condition of their plant so that they can better direct their maintenance and shut down activities.

From an internal perspective, "We have new management improving the company culture and quality to drive our offering towards industry's real needs," he continues.

"We see ourselves as a blue oceans company that will never cut corner to compete. We are a speciality company that thrives on innovation and new technology and we are continually helping our NDT technicians to know and do more.

"We see modern and speciality inspection as an integral part of fabricating and operating safe, efficient and reliable modern plants. It raises quality levels, reduces failure risks, increases reliability and therefore benefits owners, operators, employees, customers and the broader society," Meerholz concludes.



Some examples of inspection methods and indications: 1: visible dye penetrant testing of a pump casing; 2: Fluorescent MPI of a mine pump shaft with multiple linear indications; 3: Fluorescent MPI of a turbine diaphragm with an indication on the bolt hole; 4: Fluorescent MPI of turbine rotor showing a linear indication on the exhaust side of the blade aerofoil.

Handheld LIBS analysers simplify carbon and carbon equivalent testing for carbon and stainless steels

Gammatec SciAps Product Specialist for non-destructive testing (NDT), Lyndon Momberg, talks about positive material identification (PMI) for measuring carbon in steels and carbon steels as part of residual element analysis (RE) in HF alkylation units. He compares the traditional technique that relied on spark OES technology and compares it to the modern much more compact and effective handheld LIBS analysers.

Recommended Practice 578 (Material Verifications for New and Existing Alloy Piping, 3rd Edition) now recognises a new handheld technology, Laser-Induced Breakdown Spectroscopy (LIBS), for the measurement of carbon and other alloying elements in steels and stainless steels.

Handheld LIBS, developed by US instrumentation company SciAps, has found wide use in refining and fabricating for its ability to measure carbon content in stainless steels at suitable levels to separate low carbon (L) and high carbon (H) grades of stainless steel. Virtually every major pipeline owner/operator or its non-destructive testing (NDT) provider now uses a LIBS device for carbon content and carbon equivalent (CE) testing, most notably for determining the weldability in pipeline steels (API 5L).

A growing application for LIBS technology is residual element (RE) analysis in steels for hydrofluoric acid (HF) alkylation units, as per API 751. The most common RE formula employed is [Cr%+Ni%+Cu% < 0.15%]. In fact, this RE formula only applies to steels where the carbon content exceeds 0.18%. If carbon content is less than 0.18%, the more easily achieved RE formula [Ni%+Cu%<0.15%] may be used.

While still delivering the required spectral range and resolution for carbon and required transition and heavy metals, SciAps Z series LIBS analysers are much smaller because they analyse much less material.

So why is the more stringent RE formula used? Historically,

Ideally suited to scrap metal sorting, the SciAps Z can determine carbon content in steels and stainless steels and is now a proven handheld technology with nearly 600 global installations.

SciAps Z analysers use a tiny argon canister that fits into the handle of the device instead of a 40 lb+ argon tank.

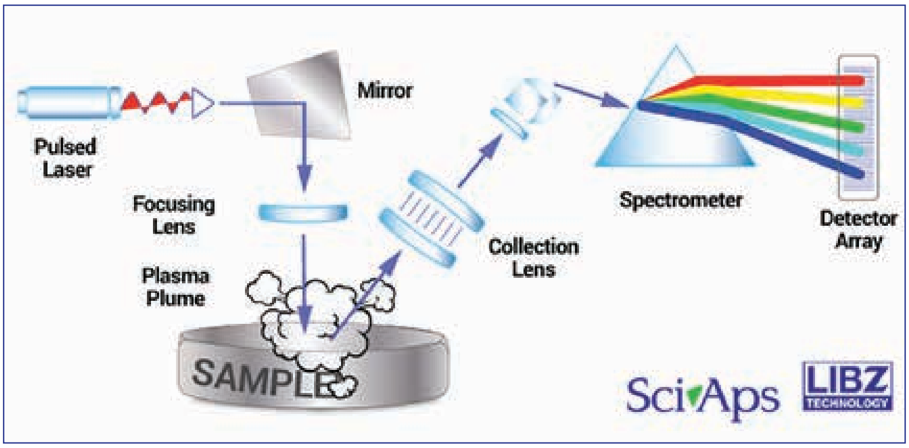
operators use handheld X-ray guns to perform Positive Material Identification (PMI) for HF alkylation units. Handheld X-ray cannot measure carbon content, so it is assumed that carbon exceeds 0.18% and the more conservative RE formula, including Cr content, is utilised. Despite this limitation, X-ray has been preferred because it is much easier to use and far more portable than the carbon-capable spark OES technology.

In short, operators prefer the more conservative RE (which is tougher to meet) so they can use handheld X-ray, instead of lugging around spark OES units and the large tanks of accompanying argon gas.

LIBS technology offers a method of measuring C, Cr, Ni and Cu simultaneously using a single handheld device. If carbon is < 0.18%, then the device may use the more relaxed RE formula for only Ni and Cu. This means more incoming and in-service materials can meet the residual limit, because their Cr content can be omitted. In addition, the LIBS carbon measurement is increasingly useful because more steel product originates from recycled material than virgin iron ore, so residual levels, especially of Cr and Cu, have steadily increased over the years, making it more challenging to obtain steel product that meets the 0.15% RE requirement.

Carbon testing pre-2017

Until 2017, spark OES was the only technique for in-field carbon analysis.



LIBS is an OES method like spark, but the bulky spark source is replaced by a very small high-powered pulsed laser.

Spark OES works by generating a high frequency electric spark that heats and burns into the metal and creates an electron plasma.

Spark OES has a number of challenges. An experienced, well-trained operator is a must. Analysis requires an inert gas environment, usually argon, so spark systems are equipped with a large (40 lb +) metal container of high-pressure argon. Users have to purge the spark system before using it and, before moving to the next location, they need to turn off the argon supply then re-purge and recalibrate at the new location, slowing down throughput. Argon runs continuously during testing, thus a large tank is required. Until recently, however, Spark OES was the only option for in-field carbon work.

What is LIBS?

Many of the people who launched SciAps in 2013 were innovators in the handheld X-ray industry, having been founders and/or employees at the two leading handheld alloy analyser companies Niton and InnovX (now Thermo Fisher Scientific and Olympus). X-ray technology had become rock solid for PMI, including for testing residual transition metals such as Cr, Cu and Ni. Despite the advancements in X-ray, there remained a significant limitation to handheld X-ray: carbon. Due to the extremely low energy of carbon X-rays (and other low atomic number elements such as lithium, beryllium and boron), there is no practical way to measure carbon or similar 'light elements' with a handheld X-ray gun.

Yet carbon concentration is the critical measurement for steels and stainless steels.

So the SciAps founders got to work developing a way to analyse carbon with a handheld device. LIBS is an OES method like spark, but the bulky spark source is replaced by a very small high-powered pulsed laser. SciAps miniaturised the laser and other key components into a 4.5 lb handheld device. This breakthrough required three major innovations:

1. To replace the power-hungry high voltage sparking system with a miniature pulsed laser: The SciAps laser delivers a pulsed beam into a tiny spot (100 µm), in a very short time scale (1 ns), and can therefore be powered by an on-board battery.
2. To re-invent the purge process: The narrow laser requires a small purge volume (a few millilitres/ccs). Between tests the argon flow is also halted. The result is about a 1 000x reduction in argon consumption, allowing a tiny canister in the handle of the device to replace the 40 lb+ argon tank. One argon canister can deliver 600 burns or 600 PMI tests. The smaller canister also makes the Z-series SciAps LIBS analyser easy to carry, without having to shut off argon and re-purge.
3. To miniaturise the spectrometer: While still delivering the needed spectral range and resolution for carbon and required transition and heavy metals, the spectrometer is much smaller as it is analysing much less material.

The resulting device – the SciAps Z – now has nearly 600 installations worldwide in the petrochemical, pipeline and steel fabrication industries. It is recognised in RP 578's 3rd edition and has been evaluated favourably in comparison to spark OES systems in numerous independent studies by leading users and institutes for C and CE in pipeline steels, L-grade stainless, residuals, and even sulfidic corrosion applications.

Ultrasonic Testing: Writing the perfect written instruction

Harold Jansen, SAIW's systems and quality manager, has begun to create a series to help welding industry NDT professionals to produce quality documentation. In this first article of the series, he used a UT example to outline the basic principles.

Typical NDT related quality documentation refers to the company's written practice or procedure relating to personnel training, qualification and certification, and it must include method and/or sector specific procedures, written instructions, technique sheets and record sheets. This article aims to provide guidance on the compilation of these documents and to create, through mutual interaction, examples of industry norms.

What is a written instruction?

It is a document created by a Level 2 NDT technician that contains detailed instructions as to how a non-destructive test is to be performed by a Level 1 NDT technician. The written instruction is based on a procedure compiled and validated by the responsible Level 3 NDT technologist.

The written instruction forms part of the overall data package, which should include the NDT procedure and report. The report, in turn, consists of the technique sheet, containing essential parameters to allow repeatability of the test, and the record sheet shows the indications found and the characterisation of each indication in accordance with its position, orientation, type, length, width and depth.

What does a written instruction consist of?

A written instruction can be created in numerous formats. The format used at the SAIW has been designed to provide guidance to students, as opposed to being a mandate of a specific layout. It consists of five sections: Scope; Resources; Preparation; Process and Conclusion.

Scope

The scope defines the parameters of the test to be performed and therefore stipulates the method and technique to be used, the sample to be inspected, the relevant inspection standard, the purpose of the inspection and any restrictions or limitations that might be present. The inclusion of acceptance criteria would not be mandatory, since the Level 1 is not supposed to evaluate the results unless clear instructions are provided in the written instruction.

As an example, let's assume the butt weld configuration shown in the Figure 1 weld should be inspected using the ultrasonic testing (UT) method.

Resources

Resources relate to personnel, equipment, calibration blocks and reference samples as well as consumables to be used. While detail regarding personnel is usually mentioned in the method procedure, no restriction is placed on whether Level 1 or Level 2 personnel perform the inspection. However, signing the report is restricted to a Level 2 technician.

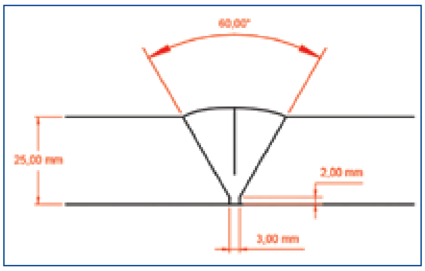


Figure 1: A butt weld to be inspected using the ultrasonic testing (UT) method.

Operational and functionality checks (calibration and verification) are usually covered in the method procedure and only pre-test calibrations, as part of preparation, are mentioned in the written instruction, since it is assumed that the written instruction is followed just prior to the inspection, normally on site.

Minimum resource requirements are usually detailed within the relevant inspection standards and consequently included by the Level 3 in the method procedure. The difference between the procedure and the written instruction is that the instruction stipulates exactly what resources are to be used without allowing any variation, while the procedure relates to resources in general.

Preparation

Preparation refers to actions required to prepare the sample, equipment, personnel and environment for the test, and includes details relating to: safety, access, identification and orientation, surface preparation and cleaning, equipment verification/pre-test calibrations and personnel adaption.

Process

The process describes exactly how the test must be conducted from start to finish, which includes surface cleaning and restoration (if required). It is advisable to include a summary of the overall process prior to compiling the detailed process to

Scans to be performed	Purpose	Scan Pattern (overlap, beam spread), speed, etc	Probe (type, angle, etc)	Scan distances (Calculated and verified)	Range settings Calculated & verified	Scanning sensitivity	Recording sensitivity
Parent metal							
Critical root							
Fusion face							
Weld body + HAZ (longitudinal indications)							
Weld body + HAZ (transverse indications)							

Table 1: Summary table outlining various aspects to be considered for a UT inspection.

enhance overall understanding and ensure that the scope is covered.

Based on the scope, it is useful to construct a table outlining various aspects to be considered with reference to the relevant procedure and consequently standard.

Scaled drawings should be created for each of these scans, so as to confirm that the parameters provided would allow full scope coverage and detection of all relevant indications, and provide a quick verification that relevant calculations are in fact correct. Sample drawings for the critical root scan and the weld body and HAZ scan for longitudinal indications are shown here.

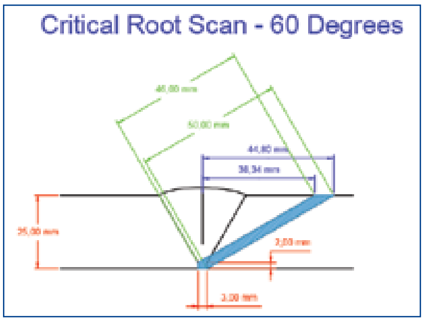


Figure 2: Critical root scan diagram (60° shear wave).

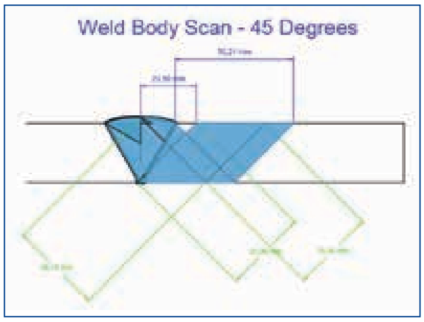


Figure 3: Body weld and HAZ scan for longitudinal indications (45°, 60° and 70° shear wave).

Conclusion

The report conclusion refers to the interpretation of indications (pattern recognition), recording (parameters) and evaluation (accept/reject) of defects and the consequent reporting of all these components in a suitable report format.

For this UT related article and for future articles in this NDT series, more detailed sample reports that include all the required diagrams – and detail for typical quality documentation – based on either ISO or ASME standards, will be made available via the SAIW Website.

NDT Professionals and SAIW members are encouraged to participate in continuously improving these documents for the benefit of fellow professionals.

NDT Level 3 workshop success and future opportunities

The Southern African Institute of Welding is proud to announce that its flagship NDT Level 3 workshop has again risen to expectations with nine students having attended the first workshop for 2020. Based on initial feedback, this group of individuals is promising to achieve the best outcomes of all Level 3 workshops since 2010.

This challenging seven weeks, which will expanded to eight weeks in future programmes, allows individuals who want to become Level 3 NDT personnel to attend classroom training in accordance with the relevant basic and main method requirements and to write qualification examinations via SAIW Certification.

A second workshop has already been scheduled for June and July 2020, based on customer demand. This workshop will introduce the very first Visual Testing Level 3 course and exams, which is now possible since the number of VT 2 personal has significantly increased in the past three years.

Who can attend?

Individuals seeking ISO 9712 Level 3 certification should have a current ISO 9712 Level 2 certificate in the relevant method and sector, or they must at least have passed a Level 2 qualification examination within the previous six months. Certification requirements in the latter case would then require an industrial experience log for both Level 2 and 3 to be submitted for the candidate to be certified.

Level 3 certified individuals whose Level 2 certificates have lapsed are welcome to contact us in order to re-instate their Level 2 certificate, which can be done via a full Level 2 practical examination. The dates of the Level 2 and 3 certificates would then run concurrently with that of the existing Level 3 certificate.

Experienced company certified Level 2 personnel are also welcome to participate but will have to successfully complete an ISO 9712 Level 2 qualification examination via the transition programme to be eligible for the Level 3 workshop. If successful in the Level 3 examinations and once certification requirements have been met, a Level 2 and 3 certificate would be issued as per the normal application process.

In addition, senior engineering or managerial staff are welcome to attend this workshop as part of a continuous personal development (CPD) programme, which will not require an examination to be written. A formal attendance certificate would be issued instead. This training can then be credited should the candidate want to become a qualified NDT operator, technician or technologist.

Alternatively, these individuals could attend the one day Appreciation of NDT for Engineers course, which aims at providing the necessary NDT information in a very condensed format.

What does the workshop entail?

The Basic NDT Level 3 component is made up of three aspects: basic metallurgy and materials (Part A); qualification and certification systems (Part B) and Level 2 knowledge for all NDT methods (Part C), which deals with the six main methods, which are: magnetic, penetrant, visual, eddy current, radiographic and ultrasonic testing. The Basic NDT Level 3 module consists of a two week classroom training programme followed by three exams, each representing one of the modules.

It is essential that candidates pass this Basic component in order to gain access to the main method exams, therefore two rewrite opportunities are allowed for during this workshop.

Each main method training course consists of a theoretical (general theory), application (ASME-2019 & ISO based applications) and practical (procedure writing) components that cover the following ISO TS 25107 aspects: Introduction & Terminology; Physical Principles; Developments; Product Knowledge; Equipment; Pre Test Info; Testing; Evaluation; Assessment; and Quality Aspects.

The main method examinations consist of four parts, which are: the General (Part D); a two part Specific examination (Part E1, a closed book exam and Part E2 an open book exam) and a Practical (Procedure) examination.

The pass mark for all examinations is 70% and only those examinations that were not passed would have to be rewritten. Two rewrite opportunities are allowed after a month and within a two-year period from completing the initial examination.

Individuals or companies interested in attending this workshop are encouraged to contact the SAIW as soon as possible in order to make bookings, since space is limited.

Companies are encouraged to contact Mark Digby should they wish to consider a group booking.

Arc-welding-based additive manufacturing for body reinforcement in automotive engineering

In this paper from the 72nd IIW International Conference of Bratislava, Slovakia last year, A Josten of CarlCloosSchweißtechnik and M Höfemann of Salzgitter Mannesmann Forschung (SZMF) describe two possible applications of arc-welding-based additive manufacturing in automotive engineering with the goals of producing vehicles more efficiently and reducing the environmental impact of the vehicle production processes and the vehicles themselves.

Welding no longer only means fusion welding or thermal coating. In recent times arc-welding-based additive manufacturing has become more important for generating parts consisting of weld deposits. Cost-efficient and fast part production, plus their improved mechanical properties are some of the arguments for arc-welding-based additive manufacturing [1].

So too, in automotive engineering this manufacturing process can help to reinforce body components by generating stiffening elements by deposition welding. Benefits of this simple and flexible method are more flexural rigidity even though comparatively less material volume is used and the ability to quickly modify and use the system for many other applications.

In this study an advanced short arc welding process with low-heat input was chosen. Special feature of this process include a bidirectional wire motion during welding for a better drop separation and therefore almost no formation of spatter. These experimental welding trials were subdivided into two fundamental topics. The first was to check the possibility of generating a gusset plate on zinc coated car body parts by additive manufacturing to reinforce a right angle of bent thin steel sheet. The second topic was to increase flexural rigidity of the sheet by depositing weld metal in a grid.

Bend tests of the grid sheets indicated clearly increased flexural rigidity compared to the parent material. Even though the total heat input into one sheet is comparatively high, a carefully selected welding sequence along with a clamping device can keep warping to a minimum. The very stable arc can overcome previous weld lines and results in good penetration especially at the intersection points.

Transverse microsection examinations show generally good penetration and layer structure. Finally the welds are visually appealing. This production method and the results of this fundamental study may be interesting for automotive engineering, and for other applications such as additive production of any components to reduce material expenditure if reinforcement or high rigidity is demanded.

While many studies investigate(d) the properties of components that are generated by multi-layer applications such as these, this fundamental study is intended to show two possible applications of arc-based-additive manufacturing processes in automotive engineering with the usual goals of producing vehicles more efficiently and reducing the environmental impact of the vehicle and its production. The aim is to show how these goals could be approached, what difficulties and limitations still exist at present and where further research work could be initiated.

Introduction

Arc-welding-based additive manufacturing, also known as 'wire and arc additive manufacturing (WAAM)', has become important for generating parts by depositing layers of material via fusion welding. Cost efficiency and fast part production, plus improved mechanical properties are some of the arguments for arc-welding-based additive manufacturing [1]. High deposition rates at lower investment and operating costs compared to powder-based processes are of particular interest for the production of large-volume components [2].

But in order to become more interesting as an arc process for increased use in the field of additive manufacturing in research institutes, for example, the development of energy-reduced digitally controlled short arc processes and the simplified use of industrial robots for torch manipulation was an important milestone for welding industries [1].

Wire and Arc Additive Manufacturing (WAAM)

Categorization of processes for AM [3]

Additive manufacturing often means building up complete components by adding layer on layer. There are some processes that can be applied for this purpose. A categorisation according to feedstock (filler material) – which is deposited layer by layer – and heat source is shown in Figure 1.

An arc-based process with an endless wire electrode, which is similar to the functional principle of Gas Metal Arc Welding (GMAW),

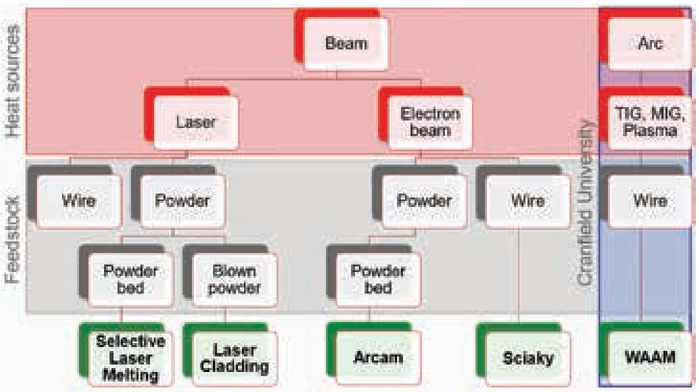


Figure 1: Categorisation of processes for Additive Manufacturing (AM) [3].

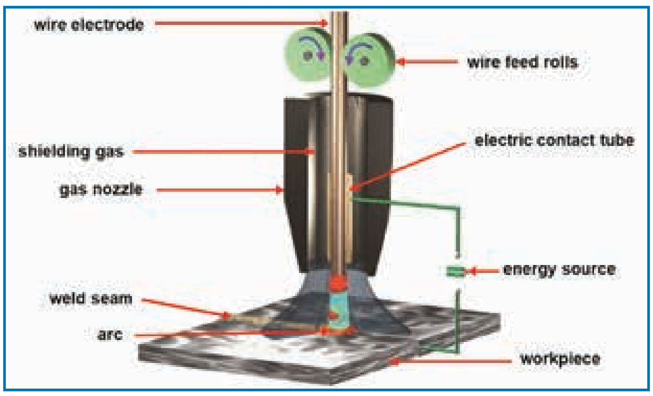


Figure 2: The functional principle of GMAW [4].

is well suited (Figure 2). In this process, an electric arc burns between a continuously fed wire electrode and the workpiece. The arc is surrounded by a shielding gas that protects it from the negative influence of the atmosphere. The main parameters are welding current and voltage, which are adjusted for most power sources by wire feed speed and fine arc length adjustment.

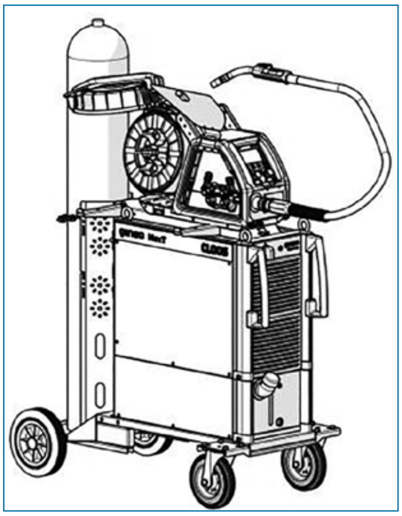


Figure 3: The layout of a modern GMAW power source [5].

Another important parameter is welding speed, which is defined by robot movement and speed. The end user can potentially combine any brand of power source and robot. This is managed by software, which controls the process. Furthermore, the user can change any deposition parameter. A scheme of a modern GMAW power source is shown in Figure 3.

Of particular interest for additive manufacturing are the digitally controlled short arc processes, which can reduce thermally induced residual stresses. In order to achieve this, certain current and voltage curves are pre-programmed, partly in synchronisation with defined wire movements. This leads to particularly low-energy material transfer that is achieved at relatively high deposition rates – general reported at between 1.0 and 4.0 kg/h. For additive manufacturing, special features of arc-based welding processes are currently the subject of intensive research and must be taken into account. High heat input and material input due to the arc lead to thermally induced residual stresses [2].

WAAM seems to be one of the most promising technologies for additive manufacturing. It is known for high productivity, high energy efficiency and low raw material cost [6]. Compared to other metal additive manufacturing processes, the wire and arc additive manufacturing (WAAM) process gives easy accessibility to the point of welding. Further benefits include: flexibility in the shape and material of the component; material savings compared to forged parts; no forming tools are necessary; short-term rearrangement for other shapes and materials is possible; high material quality due to heat treatment effects associated with multi-layer welding, in particular, uniform and isotropic toughness as well as adding material to an already heated workpiece [1].

Despite all the benefits some drawbacks delay or inhibit the diffusion of WAAM into industry. Some issues to be clarified are, for example: the layer deposition strategy to reduce residual stress and strain; assuring a constant height for each layer; as well as matching the required geometry [6] and its necessary accuracy, which is often compromised due to the 'stairstepping' effect [7].

Body reinforcement in automotive engineering

For material savings and stiffening, additive manufactured parts can be used for example in automotive engineering, as shown in Figure 4.

But why only create whole parts using weld deposition? Adding material to an existing component is real additive manufacturing, too. In automotive engineering WAAM could help to reinforce body components just by generating stiffening elements (Figure 5). In order to stiffen flat areas of car body sheet, it is possible to apply a grid of weld metal. For the stiffening of angles, a gusset plate consisting of weld deposits can be created.

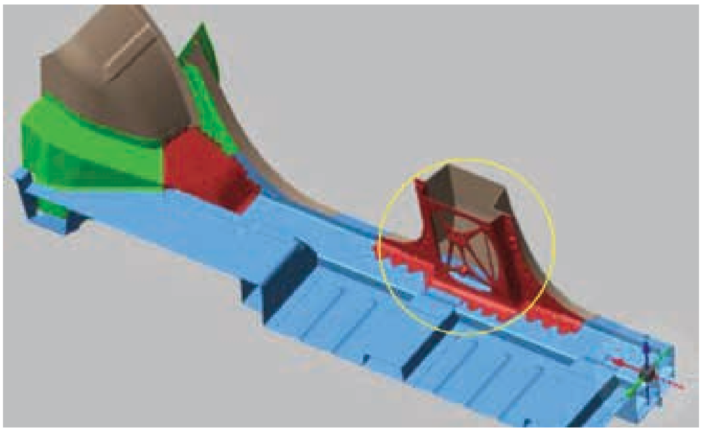


Figure 4: A laser additive manufactured (LAM) centre pillar component for a motorcar [8].

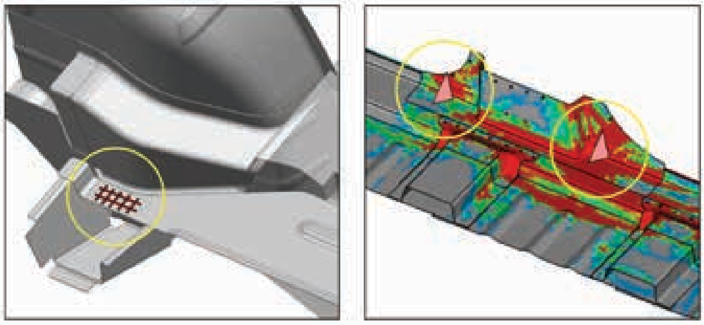


Figure 5: Possible applications of arc-based additive manufacturing in automotive engineering.

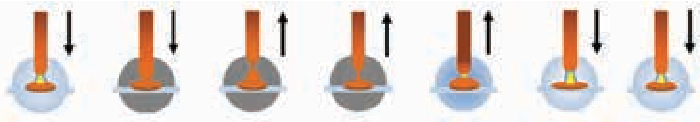


Figure 6: One cycle of drop transfer for the case of the 'MoTion Control Weld' welding process [5].

In theory, the changes in the cross-section as well as the heat treatment as a result of welding are intended to increase stiffness. In addition to the benefits described above, the benefits of this simple and modifiable method could be more flexural rigidity, even though comparatively less material volume is used and the system can possibility be reconfigured for use very quickly for many other applications.

Experimental procedure: *Welding process: MoTion Control Weld*

In the case of manufacturing thin 3D components, a low-energy welding process is needed. Standard processes get unstable at this level of welding energy and much more spatter formation occurs. In this study an advanced short-arc welding process with low-heat input and a very stable arc was investigated and chosen. A special feature of this process is the bidirectional wire motion during welding for a better drop separation and therefore almost no formation of spatter, as well as a more stable arc. In each cycle, one drop separation occurs. The wire electrode is fed forward until the voltage almost reaches the zero value (short-circuit). At this moment the drop passes into the weld pool. The short circuit acts as a trigger to move the wire backwards in a defined way. The droplet is detached cleanly, which results in significantly less weld spatter. The wire is fed back further until a certain (set) arc length is reached and the cycle is repeated (Figure 6).

Figure 7: The main components of a welding system with bidirectional wire movement.

This is realised by a special powerful motor (Figure 7, 'MoTion Drive'), which provides the small high-frequency movements of the wire. This regulates the arc-on-time and, as a consequence, the heat energy can be reduced to a minimum because the metal transfer is mainly performed by the forward and backward movements of the wire. The 'MoTion Control Unit' (Figure 7) serves as a wire buffer, from which the motor, as described above at a high frequency, can pull and push the wire as needed. From the rear part of the system, the wire is only fed forward, never backwards, and only when the buffer needs to be filled. The value of the wire feed speed, therefore, is only as an average forward speed.

These experimental welding trials were subdivided into two fundamental topics. The first was to check the feasibility in principle of generating a gusset plate using additive manufacturing for reinforcing a right angle bend in thin steel sheet while on a car body in different areas. The second topic was to increase flexural rigidity of flat sheet by depositing weld metal in the shape of a grid. A subsequent bending test would show whether, and how much, increase in strength could be achieved.

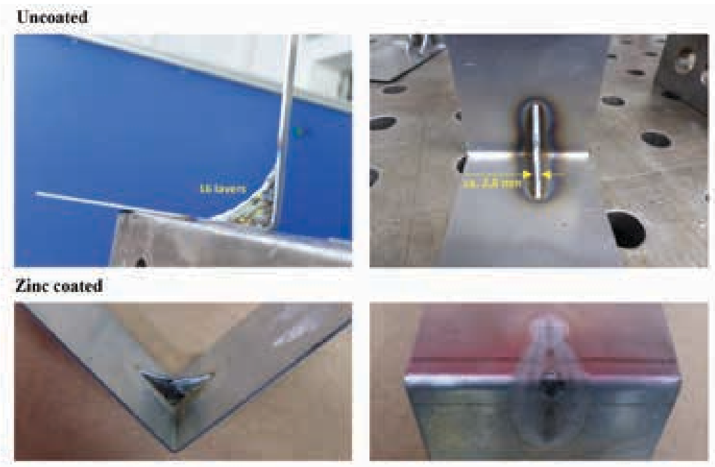


Figure 8: Welding results of additive manufacturing of a gusset plate on steel sheets of 2.0 mm thickness. Above, uncoated. Below, zinc coated.

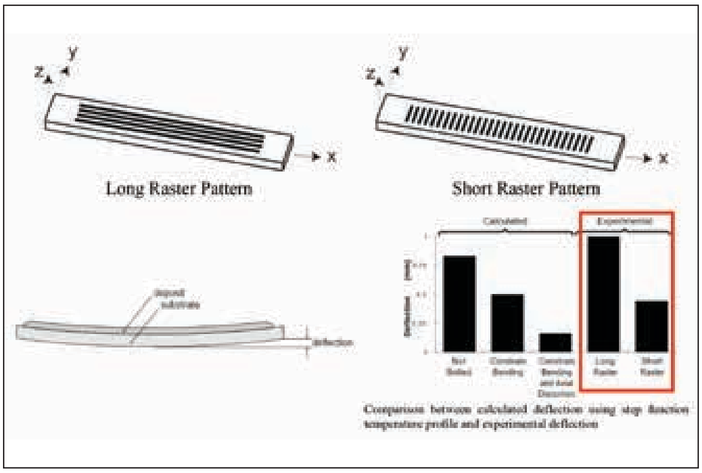


Figure 9: The results of a study showing how deposition length and welding direction affect deflection/heat distortion [10].

Gusset plate trials

Preliminary welding trials (Figure 8) on uncoated (above) and zinc coated (below) steel sheets of 2.0 mm thickness showed that alternating welding in the flat position with a break of about two seconds after each weld seam seemed to achieve the best results. In these experimental tests, it was found that the opposite weld direction resulted in lower distortion. Simulations of temperature profile show that in multilayer welding, the same weld direction of the beads leads to much greater distortion than the opposite direction [9]. This was therefore applied to the body parts.

The minimum achievable thickness depends mainly on the diameter of the filler wire used. The wire diameter was 1,0 mm and the thickness of the gusset plate shown was about 2.8 mm. The welding current was reduced with increasing numbers of layers, so that the cooling time could remain the same. In the next step, this was tested on car body parts (Table 1). These were electrolytically or hot-dip galvanized parts 0.7 mm thick. The following parameters were set for welding to these body parts:

Grid reinforcement trials on uncoated steel sheets

Preliminary tests on steel sheets of 2.0 mm thickness showed that alternating welding in the flat position with a break of about 2.0 seconds after each weld seam seemed to achieve the best results. This is consistent with the findings of a study in this regard. The theory is that depositing a long grid pattern leads to more deflection (Figure 9) than a short grid pattern [10].

A subsequent bending test should show whether, and how much of, an increase in strength could be achieved. A bending test according to VDA-238 was planned. In order to be able to evaluate the direction of the grid in comparison to the bending axis, additional diagonal grids were welded on. Three samples were to be investigated (Figure 10): the base material and the orthogonal and diagonal grids. The distance between each weld seam was kept equal. The welding parameters are listed in Table 2.

Number of layers	9
Welding current	52 A
Voltage	11.6 V
Wire feed speed	1.2 m/min
Welding speed	80 cm/min
Shielding gas	92% Ar + 8% CO_2
Filler material	G3Si1, Ø1,0 mm
Base material	Steel, electrolytically galvanised

Table 1: Experimental assembly and parameters for welding a gusset plate onto car body parts.

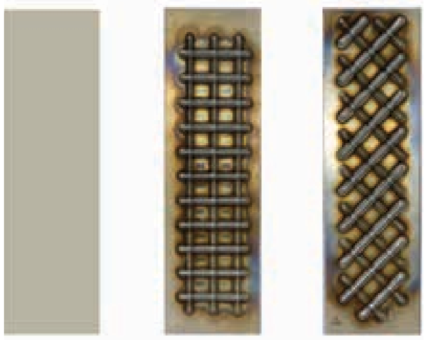


Figure 10: Three types of samples for bending test: without a grid, with an orthogonal grid, and with a diagonal grid. Thickness: 2.0 mm; length: 200 mm; width: 60 mm.

	Long patterns	Short patterns
Welding current	120 A	104 A
Voltage	13 V	16 V
Wire feed speed	4.1 m/min	3.4 m/min
Welding speed	150 cm/min	120 cm/min
Shielding gas	92% Ar+8% CO_2	92% Ar+8% CO_2
Filler material	G3Si1, Ø 1,0 mm	G3Si1, Ø 1,0 mm
Base material	Steel	Steel

Table 2: Parameters used for welding the grids on uncoated steel sheets.

Grid reinforcement trials on zinc coated steel sheets and car body parts

To be able to evaluate the applicability on zinc coated steel sheets, welding was also tried on these (Figure 11). The short patterns were welded first.

As is known, slicing the models from large components is not necessary, but rather the welding sequence needs to be carefully selected so that the thin body panels do not deform too much. Furthermore no complicated programming was needed. Simple lines were sufficient.

On the car body parts the long patterns were welded first. The parameters in Table 3 were used for welding to the body parts with assembly the same as in Figure 11.

	Long patterns	Short patterns
Number of welds per grid	3	6
Welding current	45 A	35 A
Voltage	15.3 V	14.6 V
Wire feed speed	1.0 m/min	0.7 m/min
Welding speed	100 cm/min	60 cm/min
Shielding gas	92% Ar+8% CO_2	92% Ar+8% CO_2
Filler material	G3Si1, Ø 1.0 mm	G3Si1, Ø 1.0 mm
Base material	Steel, galvanized	Steel, galvanized

Table 3: The parameters used for welding grids onto zinc-coated sheets and car body parts.

Bending test

The uncoated steel sheets were examined in a three-point bending test according to VDA 238-100. The experimental assembly is shown in Figure 12. A flat sheet is bent to an angled sheet until a certain bending angle is achieved. The maximum of the applied force represents the bending stiffness.

Experimental results

Gusset plate: Creating a gusset plate was tested on zinc coated car body parts (Figure 13). These 0.7 mm thick areas were hot-dip galvanized or electrolytically galvanized.

In principle it is possible to generate a gusset plate. The welds are visually appealing. At the backside of the gusset plate (where the root is), the zinc coating is damaged due to the high heat input in relation to this small area. Warping of the sheet angles during welding can only be prevented by a convenient clamping device. For implementation in the automotive industry, the aspects of the damaged zinc coating and possible warpage must be investigated and respectively prevented. It was not the subject of these experiments.

Grid stiffening for uncoated steel sheets: At the beginning of the experimental tests, welding trials on bright steel sheets of 2.0 mm thickness were undertaken to find out if it is possible to weld across weld seams and achieve full penetration at the intersection points. The welds are about 2.5 mm wide and narrow at the intersection points at about 0.8 mm (Figure 14).

Figure 11: Welding results after additive manufacturing a grid on zinc coated steel sheets of 2.0 mm thickness.

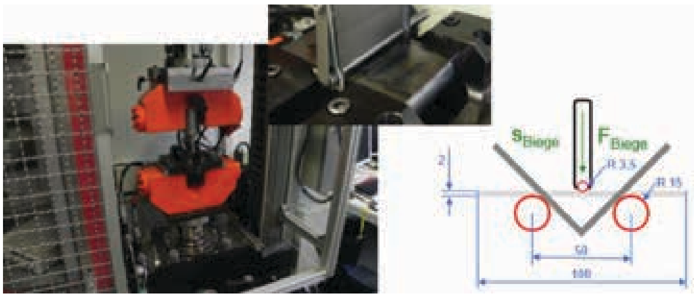


Figure 12: Experimental assembly for bending tests according to VDA-238 [11].

Figure 13: Welding results for the additive manufacturing of a gusset plate on a car body area of 0.7 mm thickness.

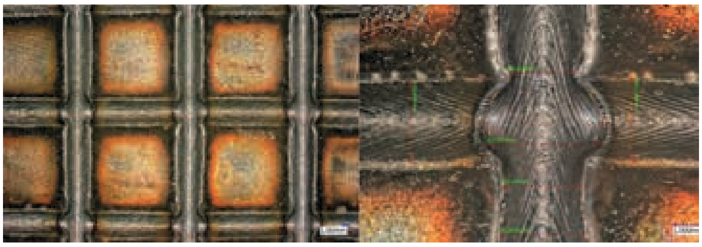


Figure 14: Welding results for the additive manufacturing of a grid on a car body area of 0.7 mm thickness.

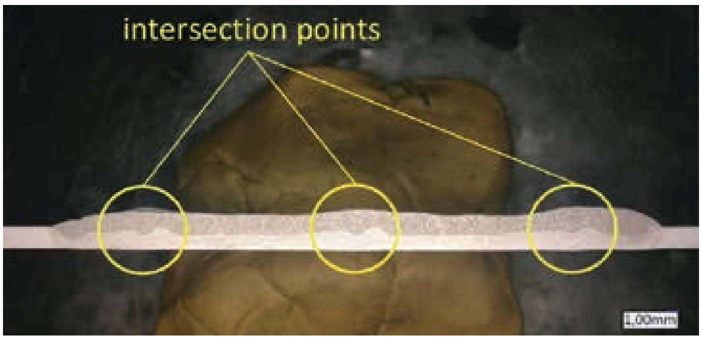


Figure 15: Welding results at the grid intersection points for the additive manufacturing of a grid onto a car body area of 0.7 mm thickness.

Intersection points:

Transverse microsection examinations (Figure 15) show generally good penetration and layer structure. In addition, it can be seen at the intersection points that the first layer is remelted very deeply and that there is no particularly large seam height. A tempering effect, as it is known with multilayer welds, is not clearly visible at the intersection points. The welding power of the second layer was deliberately chosen to be higher so that the intersection points are correctly fused. The Heat Affection Zone (HAZ) clearly extends to

Colour of curve	Test samples	Line colour on bending force vs deflection graph

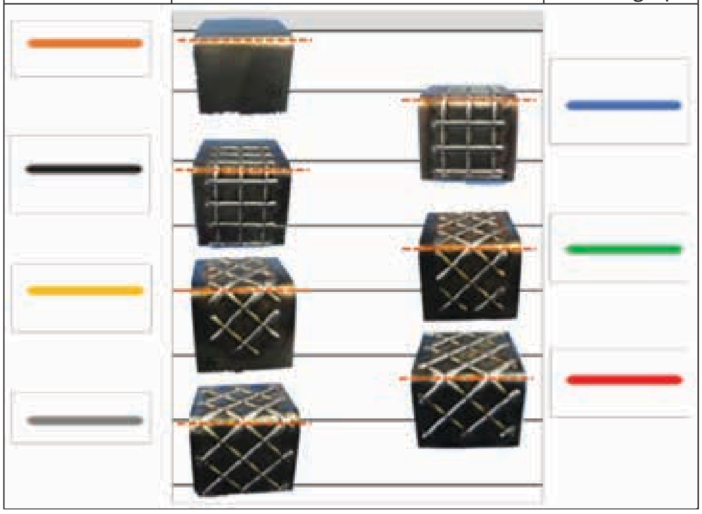


Table 4: Bending test samples and colour codes [11].

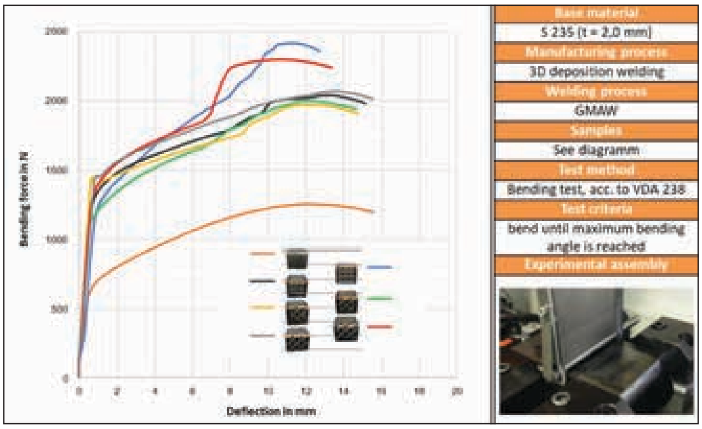


Figure 16: Bending results for the uncoated grid sheets [11].

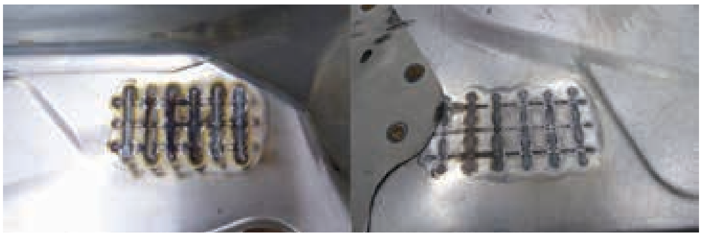


Figure 17: Welding results for additive manufacturing of a grid onto car body areas of 0.7 mm thickness.

the underside of the sheet, which is also the case for the 0.7 mm thick body panels. Finally the welds are visually appealing.

Bending test: As shown in Table 4, in total seven different examination points were defined. The base material without weld seams is indicated as orange. The orthogonal grids were examined between and on the intersection points (black and blue). The small-area diagonal grids were examined on one or two intersection points (green and yellow) and the large-scale diagonal grids were examined on two or three intersection points (red and grey).

The Bending tests of the grid sheets indicated a clearly increased flexural rigidity compared to the base material (Figure 16).

The bending force could be increased by at least 50% (yellow). The maximum increase in bending stiffness was about 90% (blue). In general, more intersection points seem to lead to higher bending stiffness, but not necessarily: the larger grid does.

The blue curve indicates that the stiffness depends considerably on the load direction relative to the grid. This should be considered when designing the component. No cracks were found in any of these bending specimens.

Grid: zinc coated car body parts: Creating grids consisting of weld deposit was tested on car body parts (Figure 17). These 0.7 mm thick areas were hot-dip galvanized.

Instead of the zinc coating it is possible to weld a grid directly onto the car body parts. At this stage of development, the welds are not as visually appealing as the bright steel sheets. Distortion/warping of the parts during welding can only be prevented by a convenient clamping device or a perfectly balanced welding sequence with optimised weld length and other parameters.

For implementation in the automotive industry, the aspects of the damaged zinc coating and possible distortion/warpage must be further investigated and prevented. This was not the subject of these experiments.

Conclusions and outlook

Currently, WAAM is mainly known as a process for ‘printing’ 3D parts. But why only create complete parts consisting of weld deposit? Using additive manufacturing to add material to an existing component has real benefits, too.

In automotive engineering, WAAM could help to reinforce body components by generating add-on stiffening elements. This method is intended to increase the stiffness of a component in a simple way and with a minimum possible increase in weight. Furthermore, the generation of stiffening structures is also possible on very complex dimensioned components.

In order to stiffen flat areas of car body sheet, one-layer deposition welding in the shape of a grid is possible and intersection points are fully fused. For the stiffening of angles, a gusset plate consisting of weld deposit can be created. It is also possible to weld a grid directly onto car body parts.

At this stage of development the welds are visually not as appealing as the uncoated steel sheets. On the underside of the parts, the zinc coating is damaged due to the high heat input (in relation to the thin parts) needed for good penetration. It is also difficult to put in enough energy to break through the zinc coating and achieve good penetration while keeping the zinc coating on the underside undamaged. For implementation in the automotive industry, aspects of the damaged zinc coating and possible warpage must be further investigated and prevented, but this was not the subject of these experiments.

In theory, subsequent milling does not make sense if welding is carried out at points that do not have to be visually appealing, only functional. So, complex hybrid systems or a complete post-processing step (milling) could be omitted. However, this may be required should a re-galvanizing process be necessary.

The bending tests of the uncoated grid sheets indicate clearly increased flexural rigidity, by up to 90% in terms of bending force compared to the base material. In general, more grid intersection points seem to lead to higher bending stiffness. The stiffness seems to depend considerably on the load direction relative to the grid. This should be considered when designing the component. During these trials, no cracks were found on the bending specimens.

On one hand, higher stiffness in bending tests is due to the change in the component’s cross-section and, on the other, to the heat treatment effect (coarse grain microstructure becomes annealed/refined). Which of these effects has the greatest influence and to what extent should still be clarified in order to achieve the best possible results.

Higher arc power and welding speeds lead to increased melting and decreased HAZ size, which is desirable for many applications. Although a higher deposition rate can be achieved with more arc power and higher welding speed, this considerably increases the penetration depth [12], which can, if the penetration depth is greater than the thickness of the sheet, be counterproductive in the case of very thin car body sheets.

The extent to which the welding heat influences the failure behaviour in component tests –due to different proportions of coarse grains in the microstructure, for example, still needs to be investigated and clarified. Furthermore, how this heat treatment effect influences the crash performance of high strength steels used in automotive engineering must still be investigated.

Over and above the described benefits, further research is needed to realise specific applications. The aspect of residual stresses must be recognised to evaluate the safety of welded products.

At present, it is assumed that the combination of structural change and changes in cross section will lead to optimum utilisation. This means that neither the application of a grid nor a structural change alone will lead to beneficial results. Mesh size could also be important.

Thinner welding wire may possibly be beneficial – 0.8 mm wire, for example – but neither welding equipment nor ideal welding parameters were available for this research.

This is an initial study, but this knowledge may be the beginning of something useful for our natural environment and for motor vehicle manufacturers.

Acknowledgements

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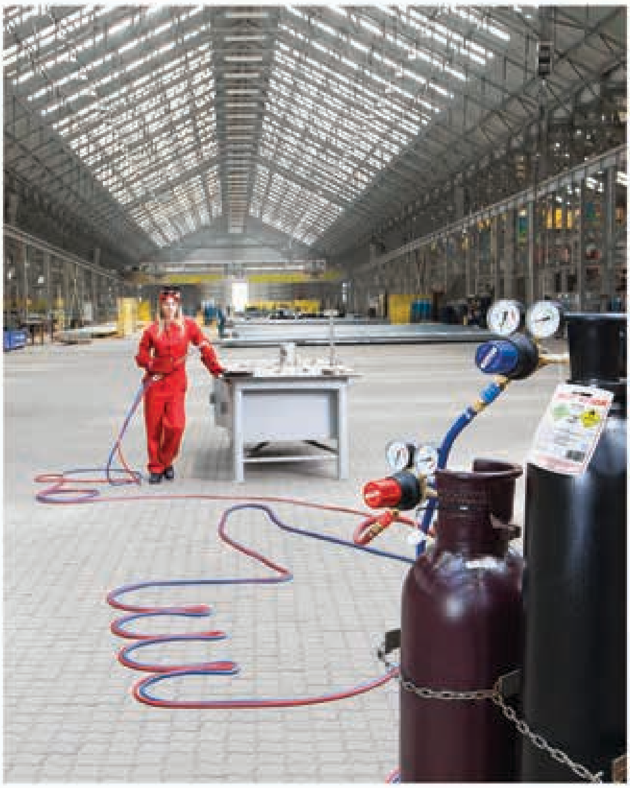

Simplifying success with ESAB's latest Aristo MIG system

Jannie Bronkhorst, ESAB South Africa's product manager for welding and automation, talks about the advantages of using the latest Aristo MIG 4004i coupled with the best possible consumable wire for the application.

In medium- and heavy-duty industrial welding applications, enhanced weld quality, reduced operating costs and welding productivity reign supreme. Manufacturers in heavy equipment are seeking every welding advantage they can find. Compounding this is the chronic shortage of skilled welders. That said, even the most skilled workforces benefit from the functionalities incorporated into today's advanced welding systems.

Take, as an example, the new Aristo MIG 4004i Pulse power source from ESAB, which pairs with the Aristo Feed 3004 wire feeder and the user-friendly U6 or more advanced U82 control panel to form a complete welding system, together with the correct filler metal.

Inverter advantage

The Aristo MIG 4004i Pulse is an inverter-based, multi-process welding power source that can be used for various processes. These include gas metal arc welding (GMAW), pulsed spray transfer (including modified pulsed spray processes such as ESAB's Super-Pulse process), gas tungsten arc welding (GTAW) and shielded metal arc welding (SMAW).

In addition to its versatility, the Aristo MIG has a footprint that is 80% smaller and weighs 70% less than conventional technology power sources with a similar output. The Aristo MIG has an output range of 4 to 400 A; a 60% duty cycle at 400 A/36 V and a 100% duty cycle at 300 A/32 V; and the machine operates from a 380 to 460 V (±10%), three-phase supply at 50/60 Hz.

Its compact size and light weight help fabricators who want to move their welding system around a large weldment, especially if they have limited space in their welding cells or want to mount the power sources on a mezzanine or pedestal to get them off the factory floor. Inverter technology also means that the Aristo MIG can help lower utility bills, as it has energy efficiency of 88% and a power factor rating of 0.94 (with a 1.0 power factor being the best possible).

Built-in intelligence

The real benefits, however, come from the system's advanced capabilities, many of which are controlled from the U6 or U82 panel. For example, they offer up to 250 pre-programmed synergic lines. Operators start by selecting the welding process, followed by wire type by AWS classification, shielding gas type and wire diameter.

Once the selections are made, the system sets the optimum welding parameters for those variables using its synergic lines. It then displays the data on the panel interface. The ESAB-designed synergic lines also help the operator avoid globular regions between short arc and spray arc where the arc becomes unstable and generates excess spatter.

The Aristo MIG 4004i Pulse power source pairs with the Aristo Feed 3004 wire feeder and the U6 or more advanced U82 control panel to form a complete welding system.

With each synergic line, there are start and stop routines set as default. Some of these functions (creep start, hot start and crater fill) can be activated by using the keys on the interface. To further fine-tune the weld settings, the start and stop data can be customised and subsequently stored – the U6 has a memory to store up to 10 welding schedules, while the U82 can store up to 255.

The AristoU82 control panel enables users to create customised synergic routines specific to their application, further optimising performance.

In addition, the U82 enables users to create customised synergic routines specific to their application, further optimising performance. Activating the trigger switch enables users to switch between pre-set welding programs during welding by quickly double clicking the torch trigger.

With the U82 panel, users can set limits on voltage and amperage, ensuring that operators cannot step outside of a set welding procedure. Further, once the weld data has been set, the control box can be locked, preventing unauthorised personnel from changing the data. Additional quality functions include storing data on the last 99 welds; monitoring production statistics, such as arc-on time and quantity of wire consumed; and exporting statistics and procedures using a USB connection.

Some of these functions are mandatory for users of this type of equipment, which also run such ESAB filler metals as OK AristoRod 12.50 solid wire.

Quick-set functionality

In a fabrication facility with 10 operators all using the short-circuit GMAW process on the same component, there is a reasonable chance of finding 10 different opinions on the settings that constitute a perfect arc. On top of that, operators new to the production line might have trouble consistently setting parameters.

To harmonise parameters between workstations, using one of the provided synergic programs in combination with the limit and lock functions is a good place to start. However, there is another way that might have more operator appeal: Q-Set.

Q-Set artificial intelligence is an innovation that improves the efficiency of short arc welding. To use Q-Set, operators push a single button and then weld for eight seconds on a sample of the joint they plan to weld. Q-Set then automatically selects the optimal short-circuit frequency for the gas/wire combination installed.

By varying the number of short circuits per second and the duration of the short, along with other variables, the machine provides ideal weld pool conditions and consistent weld quality. It can also lower spatter levels for reduced post-weld cleaning. Q-Set even adjusts for variations in electrode stick-out, such as when operators are welding in a deep corner or groove.

Q-Set, as with all of the Aristo MIG's synergic programs, provides for easy weld pool heat adjustment. To weld 'hotter and faster' or 'colder and slower' when shifting from the flat to vertical position, for example, operators simply adjust the wire feed speed up or down. The system automatically adjusts all other welding parameters to maintain optimum performance. By eliminating the technical adjustments, Q-Set allows newer operators to focus on gun manipulation and technique.

Pulsed spray and SuperPulse

Traditionally, manufacturers and fabricators selected the short arc process for reduced heat input, especially on thinner sections of stainless steel and aluminium (from 5.0 mm to 15 mm thick). With stainless steel, thermal conductivity is poor, which means that it is highly prone to warping. Excess heat also 'burns out' the alloying elements, which can severely degrade mechanical properties and reduce the material's ability to inhibit corrosion.

Conversely, aluminium, because of its excellent conductivity, is highly prone to burn through and – in what may seem a contradiction – incomplete fusion. The potential for poor fusion occurs because the weld pool solidifies too quickly and because the short arc process does not have sufficient heat to penetrate through the root of the weld. This is especially notable on square butt joints and fillet welds.

Pulsed spray and Super-Pulse (technically a modified pulsed spray transfer process) overcome the limitations inherent in both the short-circuit GMAW and conventional spray transfer processes. With the pulsing processes, the Aristo MIG 4004i pulses the arc between a high peak current that promotes metal transfer and a low background current where no metal transfer occurs but the arc does not become extinguished.

By varying the amplitude, duration and frequency of the peak and background current, the system can more efficiently control heat input while ensuring excellent fusion.

Not only does the process reduce spatter with little to no post-weld clean-up required, it also promotes faster travel speeds and enables all-position welding and using larger diameter wires across a broad range of metal thicknesses.

When using Super-Pulse, a GTAW-like bead appearance is produced. In short, the process can increase productivity and quality while reducing weld costs in many operations.

When first introduced, pulsed spray systems offered a handful of 'canned' programs. If one of those programs did not work well, it took an expert to modify them. Today, the Aristo MIG 4004i system with the U82 control panel features 18 synergic programs or lines dedicated to pulsed spray, including those for carbon steel, duplex steel, GMAW brazing, nickel-chromium-molybdenum and five each for stainless steel and aluminium.

These synergic lines provide out-of-the-box functionality for about 95% of all stainless and aluminium applications. In addition, the system enables experts to program and store custom synergic lines, such as those for welding other alloys.

As previously mentioned, Super-Pulse provides a GTAW-like bead appearance. Traditionally, many operators enhanced this appearance by manipulating the gun with a whipping motion, directing the wire from the leading edge of the puddle back to the middle of the puddle and back again to the leading edge. It is important to know, though, that this type of manipulation can add unintended variables.

To produce the classic 'stacked dime' bead appearance without any gun manipulation, ESAB developed the Super-Pulse process. Even better, Super-Pulse enables operators to easily adjust the distance between 'stacks'. By combining excellent, customisable bead aesthetics with a consistent travel speed, the Aristo MIG satisfies the needs of welding operators, supervisors and quality control personnel alike.

Coupled with other features that appeal to operators, supervisors and owners, ESAB believes that more fabricators and manufacturers should examine the benefits of advanced systems such as the Aristo MIG 4004i Pulse units.

Extra low-slag welding wire from Hyundai Welding

Hyundai Welding Japan has developed an extra low-slag solid wire, SM-70MT, for joining galvanised steel.

During winter, calcium chloride sprayed on roads adheres to the undersides of cars, causing corrosion. Galvanised steel sheets with electro-deposition coatings are applied to car frames to prevent corrosion.

When welding a galvanised steel plate there is a possibility that corrosion may occur on the slag of the weld, since it is not electro-deposition coated. Another problem is that pores are generated in the weld of galvanised steel sheets, despite the fact that they have excellent corrosion resistance.

In cooperation with major Japanese automakers, Hyundai Welding has researched and developed welding materials and methods that allow electro-deposition coating and low porosity. They have now succeeded in developing and commercialising SM-70MT, a solid wire capable of producing welds on galvanised steel sheet that can be electro-deposition coated while maintaining low porosity.

The product has gone through various performance evaluations in cooperation with major car makers since 2017, and took part in the International Welding Show held in Tokyo in April of 2018. Having completed the performance evaluation for the past two years, the consumable is currently being applied to a production line of an automobile company that has been participating in the development process since the first half of 2019.

The main features of SM-70MT are that it is applicable to any welding equipment currently in use, and that it minimises porosity and spatter generated during welding when using optimised welding parameters.

The consumable's electro-deposition coating performance excels on conventional steel sheets as well. This is due to the decreased slag production that is not only present on galvanised steel sheets – and the corrosion performance of the finished weld excels even in briny environments.

Hyundai Welding products are distributed in South Africa by Argon Arc Welding.

www.argonarcwelding.co.za

WAAM and Fronius' CMT solution

Harald Maringer, Fronius International's key system manager for Wire Arc Additive Manufacturing (WAAM) talks about the advantages of using Fronius' Cold Metal Transfer (CMT) welding process for producing prototypes and high-value small-batch components, as opposed to using more expensive wire- or powder-based metal additive processes.

Additive production methods generate components by building up material layer-by-layer, the most well-known example being 3D printing. WAAM, which is based on the arc welding process, also produces metal parts layer by layer, with the layers formed by melting and fusing a wire electrode. This generative method is particularly advantageous when complex component geometries have to be produced, as the design options are virtually limitless.

In addition, parts can be manufactured at low cost and extremely quickly – which makes WAAM a very attractive option for prototype construction and/or small production batches. In comparison, processing time, tool wear and material loss during traditional machining – especially with the conventional approach of milling out the workpiece from a solid block – all result in significant additional costs.

There are a number of generative production methods for metals. Essentially these can be divided into two fundamental types: powder-based processes and wire-based processes. In powder-based processes, the layers are built up using molten metal powder. The most common method, the powder bed process, produces extremely precise results, but is somewhat slow in production. Wire-based processes, on the other hand, build up the component by melting a wire-based filler metal, using a laser, electron beam, or a welding arc. These processes have a high deposition rate and therefore help to cut production times.

Wire arc additive manufacturing is a wire-based process that uses the gas metal arc welding process (GMAW). WAAM itself offers a number of advantages. First is its high deposition rate (up to 4.0 kg/h with steel materials), and multi-wire solutions could give rise to even higher deposition rates. Equipment and material costs are also important criteria, which is another strength of WAAM: all you need is a suitable welding system. There is no requirement for costly special equipment, such as the vacuum chambers needed for the faster electron beam process.

In comparison to powder-based processes, WAAM benefits from the immediate availability of a range of certified wire types. Since the use of metal powder is a relatively new technology, there are comparatively few powder-based materials to choose from, as it can take years to acquire the necessary certification and to produce data sheets.

A stable welding process and effective heat dissipation are essential for WAAM. The welding process needs to be sufficiently low energy such that when a new layer is applied, the existing layers are not remelted. In other words, the process needs to be as 'cold' as possible. Furthermore, the weld layers need to be continuous, spatter-free, and consistent. If any flaws were to occur, these would be transferred to each subsequent layer.

The CMT GMAW process from Fronius, and its process control variants, meets these requirements. It produces a stable arc and a controlled short circuit with long short circuit times. This means that the heat input is very low and the material transfer is practically spatter-free, which helps to prevent flaws.

Two process control variants of CMT are particularly well suited to WAAM. One is the CMT additive process characteristic, which has been optimised for WAAM. It achieves high deposition rates while transferring very little heat into the component. The CMT Cycle Step variant reduces the arc power even further through the controlled deactivation of the arc during the process phase. However, this particularly 'cold' process does require more time to build up the layers, as the deposition rate is proportionally lower.

Real world WAAM successes

Countless WAAM components have already been produced using welding technology from Fronius in a variety of sectors. These include fan impellers for the electronics

With wire arc additive manufacturing (WAAM), components are 'welded up' layer-by-layer before being skimmed into their finished form. In the example shown, the component is being produced from titanium.

Milling thin fan impellers from nickel-based alloys for the electronics industry is an expensive business, while casting is rarely an option. WAAM is an economical alternative.

Key factors determining the quality of a component produced using WAAM are the stability of the welding process and low heat input – the Cold Metal Transfer GMAW process from Fronius fulfils these requirements.

By mechanically retracting the wire electrode used in the CMT welding process, the molten droplet is detached without the need for a high pinch current. This means that less energy is needed and longer short circuit times are achieved, resulting in a 'cold' welding process. It also virtually eliminates weld spatter.

industry, which are made from high-grade materials. Milling the workpiece is very expensive owing to the high rate of material consumption, while casting is not always able to meet the critical metallurgical properties required for wall thicknesses of just 1.5 mm. Using WAAM based on Fronius' CMT Cycle Step, the fan impeller blades can be produced from a nickel-based alloy and it is possible to repair these thin components using the process.

Fronius has also implemented an application with a partner in the aviation sector. Titanium is a frequently used material in aircraft construction thanks to its tensile strength, resilience, corrosion resistance, and low weight. The majority of the components are manufactured using subtractive methods, whereby up to 90% of the material is milled away. This results in high costs, long machining times and costly tool wear. On the other hand, components produced using WAAM need only a final machined skim to produce a smooth surface.

The titanium components produced using the CMT additive process do not exhibit any lack-of-fusion problems and they have impressive metallurgical properties. Tool costs, machining times and wear are significantly reduced, meaning that overall manufacturing costs can be brought down.

This makes WAAM a cost-effective and flexible alternative for component production. The additive process can be adopted with relative ease using welding technology from Fronius and its CMT solution.


INNOVATION
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First Cut 'strikes a new arc' with the local manufacture of Messer welding electrodes

First Cut, a leading South African distributor and manufacturer of cutting consumables and importer of premium capital equipment for steel processing, has concluded an agreement with leading German company Messer Cutting Systems to take over its South African agency.

First Cut Director Gary Willis is responsible for the company's consumables division.

Messer Cutting Systems has a long history in South Africa, and its capital equipment is being used by steel processors and fabricators throughout the country. With the conclusion of this new agreement, First Cut has seized an opportunity to take Messer's local offering to new heights.

European principal Messer Cutting Systems has a history stretching back 120 years and is a global leader in the manufacture and marketing of CNC thermal cutting equipment. However, apart from Messer Cutting Systems' excellent thermal cutting equipment, the new relationship has brought about another first for South African manufacturing. First Cut has started manufacturing the complete range of Messer welding electrodes at its factory in Benrose, Johannesburg.

"Because First Cut has always been a manufacturer and distributor of premium quality products, the opportunity to locally manufacture Messer welding electrodes was one we welcomed, as the range very much fits our quality product portfolio," explains Gary Willis, First Cut Director responsible for the Consumables Division, who will be overseeing the sales and marketing of the new electrode range.

"While there are many bottom-range, cheaper brands of welding electrodes imported into South Africa, First Cut is not in that market. Our electrodes are very much a quality mid-range product," he adds.

In themselves, welding electrodes are a comparatively low value product, he explains. "By manufacturing in South Africa, we want to save our customers the cost of importation so they can buy a top quality electrode at a reasonable price," he continues. First Cut is already calling on existing customers of the former local Messer company, the rationale being that if they have heavy steel processing equipment, it is likely they will be in the market for high quality welding electrodes.

"At present, we are manufacturing the full range of Messer electrodes. These include electrodes for welding mild steel, carbon-manganese steels, stainless steels and so-called 'problem' steels, where welding has to take place under difficult circumstances or dissimilar types of metal need to be joined together.

"We will also be manufacturing and distributing electrodes for arc air gouging and for hard-facing purposes," he continues.

As First Cut's new electrode range is being manufactured under licence from Messer, the products have to comply with German (DIN), British (BS) and American (AWS/ASME) quality standards – and samples of every batch manufactured are sent to Germany for quality certification.

As a commitment to its customers, First Cut has made a substantial investment in a high quality electrode press; as well as industry standard drying and baking ovens. Both the metal used for the rods and the flux coating are of superior quality.

Manufacturing welding electrodes also broadens First Cut's scope of services. "We have always been an expert in cutting consumables and capital equipment; however to this we have added bending and grinding. With our new range of electrodes, we are now able to supply a high-quality product for use in welding, effectively completing our holistic basket of industrial products and services.

"For anyone producing high quality fabrications or processing premium steel, the choice of Messer electrodes is one without question," says Willis. "For the supply of steel components with quality welded joints, First Cut's Messer welding electrodes offer an excellent solution," he concludes.

First Cut is now manufacturing the full range of Messer electrodes, including consumables for welding mild steel, carbon-manganese steels, stainless steels and the so-called 'problem' steels.

Company background

Since producing its first band saw blade in 1956, First Cut has grown its offering substantially and is able to meet the needs of a vast range of industries through the supply of band saw blades, circular saw blades, hacksaw blades, and other cutting consumables.

First Cut's merger with Alexander and Poole in 2001, an exclusive agent for the Starrett range of cutting tools, was a significant milestone in the company's history, as was its acquisition in 2002 of Band Sawing Services, which meant that the company could expand its services into capital equipment.

Since then, First Cut's capital equipment division has grown exponentially, thanks to its partnerships with some of the best-known global brands. The company's capital equipment division specialises in metal cutting, sheet metal processing, structural (such as CNC bending and punching), and tube and pipe processing. First Cut has also invested substantially in its service programme enabling the company to provide repairs and maintenance services for a wide range of machines, from entry level band saws to state-of-the-art CNC controlled drilling and cutting lines.

Employing 240 people, First Cut is based in Benrose, Gauteng, but has a national footprint and distribution facilities across South Africa.

Miller XMT 350 FieldPro: a process game changer for high integrity welding?

Afrox business development manager, Johann Pieterse, outlines the potentially game changing features of the latest Miller XMT 350 FieldPro multi-process welding system, which offers the potential to finally enable semi-automatic welding processes to be adopted for high-integrity root, butt and pipe welding in the petrochemical and power industries.

Available exclusively through Afrox in Southern Africa, the Miller XMT 350 FieldPro multi-process welding inverter is designed to simplify onsite pipe and other root welding applications and to improve the productivity of maintenance, repair and shut down welding activities.

"We at Afrox, with various industry partners, are currently developing high integrity semi-automatic welding solutions for the petrochemical and power generation sectors. So we have decided to take a closer look at the equipment being used in the process," says Afrox's Johann Pieterse.

The XMT 350 FieldPro is an advanced portable 425 A multi-process welding inverter that offers stick and carbon arc cutting; dc TIG and pulsed TIG with a lift-arc function; as well as advanced GMAW with pulsed MIG with RMD functionality; along with flux-cored and metal-cored features and programmes.

Although the XMT 350 FieldPro offers the user the latest high-tech technologies, it is purpose built for rugged onsite use at power, petrochemical and industrial plants, boasting, amongst others, the following features:

- Arc Reach – Remote control of the power source without a cord. The technology uses the existing weld cable to communicate welding control information between the feeder or remote and power source. This technology eliminates the need for control cords, and their associated problems and costs.
- Complete control at the weld joint – Automatic voltage drop adjustment eliminates the need to adapt to less than optimal settings due to long welding cables and all parameters can be set remotely or on the wire feeder for easy changing of setups or weld processes with the touch of a button.
- Auto-line – For portability and reliability, Auto-Line allows for any input voltage (208 to 575 V, single- or three-phase) with no manual linking. It provides plug and play convenience in any job setting and is an ideal solution for dirty or unreliable input power.

While suitable for general purpose welding, the FieldPro – with the addition of the Arc Reach Smart Feeder – has been specifically developed with semi-automatic pipe welding in mind. The traditional way of joining thick-walled pipe is to weld a TIG root into the seam first, followed by a hot pass and manual stick (MMA) fill and capping runs.

The FieldPro Arc Reach system incorporates the capability to move away from traditional manual and slow pipe welding procedures that require high levels of skill, to the semi-automatic GMAW processes, most notably, metal-cored welding.

"The process allows TIG-quality welding to be achieved utilising the advantages of simpler gas metal arc welding (GMAW) or metal-cored arc welding processes," says Pieterse. "It uses the same welding equipment for the root, fill and capping passes and incorporates two advanced weld-deposition control options, RMD and ProPulse," says Pieterse.

For the root pass, Miller has developed a technology called RMD (Regulated Metal Deposition) to control metal transfer during short-arc GMAW welding. This controlled deposition eliminates the chances of cold lapping or lack of fusion, produces less spatter and results in a higher quality root pass around the pipe. The stability of the process lessens the puddle manipulation required by the welder and is more tolerant to high-low conditions, reducing training requirements. Weld bead profiles are thicker than conventional TIG root welds, and this eliminates the need for a hot pass, again improving weld productivity and reducing welding costs.

The ProPulse feature is then used for the fill and capping passes. This optimised pulsing system operates under constant voltage (CV) mode during peak and background periods, but the ramp up and ramp down rates and the initial peak and background current levels are under constant current (CC) control.

This enables a shorter arc length to be used with a narrower arc cone and less heat input than with traditional spray pulse transfer. Also, arc wandering and variations in tip-to-work distances are virtually eliminated, providing easier puddle control for in-position and out-of-position welding and reducing welder training times. The process also improves fusion and fill at the toes of the weld, permitting higher travel speeds and higher deposition.

While improving quality and improving productivity by as much as 80%, the system is easy to use and this supports training and development of local skills in much shorter time frames than those required for traditional processes.

"The XMT 350 FieldPro is not just a product, but rather a complete welding solution that introduces new technology into the market that will add value for our customers," says Pieterse, adding that Afrox's welding application development team is currently very excited about some recent successes that may prove to be a game changer for South Africa's power and petrochemical industries. We look forward to sharing these successes with the industry in the very near future," he concludes.

The Miller XMT 350 FieldPro with its ArcReach wire feeder.

SA's first validation facility and digital welding technology

Renttech South Africa, a Bidvest Group company with a solid background in the rental and sales of welding and construction-related equipment, has become the first local validation facility to provide a service to industry validating welding equipment according to ISO 17662 standards.

ISO 3834 requires that all welding machines be validated to ensure that the actual welding current and/or voltage output delivered during welding accurately matches the parameter settings

In close collaboration with the Southern African Institute of Welding (SAIW), Renttech has improved its processes to incorporate international testing standards for the validation of welding equipment as required by companies accredited according to ISO 3834.

"In order to comply with the requirement of most big projects, construction companies need accreditation according to ISO 3834 welding quality standards. With respect to welding equipment, ISO 3834 requires that all welding machines used must be validated to ensure that the actual welding current and/or voltage output delivered during welding accurately matches the parameter settings," says Renttech's welding product manager, Johan Bester.

"An external authorised inspection authority (AIA) certified our process for the delivery of performance certificates according to ISO 17662, the equipment calibration, verification and validation standard. This is now incorporated into our ISO 9001 quality management systems via a formal scope change. All new equipment sold, as well as our rental fleet, gets validated according to this standard before reaching customers.

This is also an additional service on offer to clients for their existing equipment, irrespective of brand, and we are the first local company to provide this validation facility," Bester advises.

Renttech recently launched its new UNIarc range of welding equipment, with a host of associated cost benefits and technical advantages for customers aimed at reducing the time and cost per weld.

"For the past three years, we have been engaging with some of the best welding machine manufacturers from all over the world so as to improve and complete our range to suit the demands of our rental and sales markets.

"UNIarc is a brand that has earned itself a reputation for reliability and performance in some of the harshest South African conditions over the past 20 years, in all sectors of the industrial market. With the rapid advancement of software technologies available today, we embarked on improving our existing offering to realise the benefits of these technologies for our customers; thereby further enabling them to drive welding and fabrication efficiencies," Bester explains.

He continues: "Our challenge was to ensure that we made it easy and intuitive for the welder, while unlocking benefits for the business owner. Some of the benefits include reduced fettling costs, reduced distortion, reduced materials handling costs, more effective use of labour, and increased deposition rates in the various welding positions".

Another key requirement was to further improve reliability, speaking to the need to reduce costs-of-ownership. Various technologies have therefore been added to protect the equipment from unstable input power, voltage drops associated with fixed line input power; as well as mobile generator power. Long extension leads and improperly-sized extensions were also factors Renttech had to cater for, since these are realities in the construction and fabrication industry.

"On the back of these improvements, we have been able to increase our standard warranty from one year to a three year parts-and-labour warranty on our three-phase machines; and an 18-month warranty on our single phase units. All of this is backed up with parts and qualified technicians available across the country to ensure minimal downtime," Bester adds.

The final task for Renttech was to ensure that its advanced welding solutions and technology were still affordable to the majority of the market.

"The harsh reality is that South African fabricators are competing for local projects with international firms that employ the latest technology to reduce their fabrication cost. We wanted to make a contribution to enable South African industry as a whole to be more competitive, by harnessing the latest technologies whether they are multi-national construction companies or one-man businesses.

"We believe we have achieved this without compromising quality. In fact, most of our units offer more features than those of our international competitors at a very favourable price point," he says.

He adds that, as with all Renttech offerings, welding machines are sold 'ready to weld', with all of the necessary torch consumables and accessories, with integrated water-cooling as an option – but they can also be offered as tailored solutions based on customer requirements.

"In addition, we see training as a critical element for successfully rolling out new welding technology into the workplace. We have, therefore, included the high-end machines into our trailer-based training centre, which is available to customers wishing to ensure their welders are up-skilled and competent in the new welding technologies.

"In conclusion, Renttech SA is able to offer affordable and robust state-of-the-art welding equipment, technical assistance and process solutions to construction projects and fabricators in line with the latest methodologies and welding standards in both the sales and rental options," Bester concludes.

BMG's commitment to safer and healthier workplaces

"Global industry has instituted new legislation – even in agriculture – to protect workers from the harmful effects of welding. At BMG we believe local businesses need to be more cognisant of the hazards of welding fumes and how important it is to protect workers' health through the extraction and control of these," says Andrew Johns, business unit manager for the Tools and Equipment division at BMG.

"Airborne welding fumes are a mixture of metal fumes and gases produced during welding operations, and are harmful to workers. Toxic welding fumes can contain a mixture of manganese, chromium VI, carbon dioxide, nitrous oxide and ozone, which can cause serious short and long-term health problems.

"In line with BMG's commitment to keeping abreast with global trends, we play a critical role in local industry to ensure a cleaner, safer and healthier workplace. The process of safeguarding clean air in the work environment involves various phases, from analysis and design, to supply, installation, commissioning and ongoing support.

"Our welding products and services are tailored to meet specific customer requirements and encompass source extraction, personal protection equipment (PPE), and general filtration and extraction hoods.

Johns says that international standards for the preferred order in which welding fumes should be captured begin with source extraction, which contributes significantly to a better work environment. The next step is the provision of adequate PPE, followed by the separation of source and worker by automation, for example via extraction hoods. "General filtration and ventilation systems are also critical in keeping the concentration of welding fumes within legal limits and international guidelines. The most effective solution for a cleaner workshop is normally a combination of all these methods," he says.

Self-cleaning fume extractors are designed to remove welding fumes on-site in confined areas and spaces that are difficult to reach by fixed welding fume extraction systems.

BMG's Plymovent solutions for source extraction include portable fans, fume extractors and extraction hoses; and mobile and stationary welding fume filter units with integrated fans. The range also includes filtration systems, modular extraction hoods, fire safety solutions and oil mist filters. A specially designed workbench provides extraction and filtration for welding and grinding applications.

BMG specialists believe that source extraction is the most effective method of capturing and removing welding fumes directly from the breathing zone of the worker. An important unit in the MobilePro range is the mobile self-cleaning fume extractor, which is designed to remove welding fumes on-site in spaces that are difficult to reach by fixed welding fume extraction systems.

The PHV filter unit is a compact, portable unit that is particularly well-suited for the extraction of welding fumes at source during maintenance and moderate welding applications. This unit is fitted with two motors to ensure effective extraction, while using nozzles or extraction through the welding torch. A HEPA filter – fitted as standard – ensures high filtration efficiency and also makes the PHV unit suitable for stainless steel welding fume applications.

BMG's Plymovent PPE PersonalPro range includes helmets to protect the eyes, face and head during manual welding, cutting and grinding. These versatile auto-darkening welding helmets, with an extended side vision, provide improved visibility, comfort and safety.

An integrated lightweight Powered Air Purifying Respiratory (PAPR) unit provides protection against eye and face injury, as well as preventing respiratory problems. The PAPR unit blows clean air into the helmet, allowing the worker to weld and grind, while breathing purified air via a particulate filter. This system offers the choice of two air-flows and, for additional safety, there are 'automatic clogged filter' and 'low battery' alarms.

BMG also offers Translas plug-and-play ClearO2 systems for the extraction and filtration of fumes from welding processes, micro dust, vapours and odours. The range includes extraction torches, with various nozzles, for the safe removal of welding fumes at source. Portable extraction units are used in conjunction with fume extractor torches and are suitable for convenient use by individual and multiple welders in high-production welding environments. ClearO2 High-Vacuum units, with an automatic cleaning function by reverse compressed air pulse, offer quiet and efficient operation.

BMG's extensive branch network also stocks a wide range of inverter welders, accessories, electrodes, welding wire and PPE, designed to enhance safety and optimise productivity in all sectors where metal working is essential.

www.bmgworld.net

Machine Tools Africa 2020

High performance machine tools touch every aspect of our lives. In fact, the world may stop turning without them. Machine Tools Africa 2020 (MTA2020) will be the biggest trade exhibition of its kind in Africa and a showcase of everything that twists, turns, rotates, cuts, forms, bends or shapes things to come.

The standalone show is a Machine Tools Merchants' Association of South Africa (MTMA) event, which ensures core industry support and endorsement.

Feedback received from exhibitors in past years has been extremely positive. The show attracts a high quality audience with thousands of visitors attending over the four days. Hundreds of sales leads will be generated, major sales are made from the stands and existing customers will have the opportunity to see live demonstrations on machinery and equipment brought in exclusively for the show.

Machine tools Africa will take place from 12 to 15 May, 2020 at the Johannesburg Expo Centre, Nasrec: Cnr of Nasrec and Rand Show Roads in Johannesburg, Gauteng.

www.machinetoolsafrica.co.za

Terra & Uranos: new welding equipment from Böhler Welding

The fabricator's challenge is to manufacture welded constructions from metal, constructions such as bridges, towers, vessels and power plants. The job needs 'a solution' but deserves the best possible solution.

With Böhler Welding's new equipment lines, Terra and Uranos, new standards are being set for conventional and special welding processes. Industry-unique matching combines welding consumable, power sources and accessories to provide reliable, consistent, high performance welding, allowing repeatable, best in class welds to be produced that welders can be proud of – and all Terra and Uranos welding equipment comes with a five-year guarantee.

Terra welding machines from Böhler Welding are suitable for the MMA; manual and semi-automatic dc TIG; and MIG/MAG processes and offer a power range from 150 to 500 A. The Terra range is perfectly matched to the needs of steel welders. Simple handling, robustness, reliability and welding programs developed by experts is what Terra stands for. Without complexity, Terra is a complete product line that offers first-class welding properties. The machines are easy to handle for the welder; user-friendly and ergonomic; and have low weight, making them deal for flexible use when welding steels.

*Above: **The Terra range of machines is easy to handle, user-friendly, ergonomic and light in weight.***

*Right: **The Uranos product line from Böhler Welding is a true multi-process inverter capable of manual MMA; ac or dc TIG with HF ignition; and constant voltage or pulsed MIG/MAG welding.***

In the power range 150 to 500 A, the Uranos product line can be used in manual MMA, ac or dc TIG, MIG/MAG, MIG/MAG pulse and multi-process applications. This true multi-process inverter – which includes TIG HF ignition – is unique in its class. The high-quality Uranos series is equipped with an energy-efficient high-tech inverter.

The included welding programs are individually matched to the Böhler Welding filler materials to ensure ideal arcing and the modular design and the coordinated components form the expandable Uranos welding system for the future – and automated welding applications are included.

Böhler Welding's is offering a five-year guarantee on all Terra and Uranos welding equipment and the range will be available in Africa South Africa within the next few months.

www.voestalpine.com/welding

The PIPEFAB welding system

Lincoln Electric has launched its PIPEFAB welding system into the local market, to deliver an ideal setup for pipe and vessel fabrication. "From machine design to arc performance, no detail has been overlooked in delivering a complete, customer-driven system that lets your shop focus on what matters most – making high-quality root-to-cap welds, faster and easier," says Lincoln Electric's Technical manager for South Africa, Thulani Mngomezulu.

From root, to cap, to final fit, Lincoln Electric's PIPEFAB™ system includes welding modes that have been fine-tuned to deliver breakthrough arc performance specifically for pipe and vessel fabrication. Developed as a fast, smart and easy solution, the system delivers straightforward and simple digital control - with one-click process selection every detail has been considered in creating the ultimate setup for the pipe and vessel industry.

Key features include:

- A better than ever Surface Tension Transfer® (STT) process, which was the original open-root modified short-circuit solution on the market. After decades of leading the industry, the performance of this iconic process has been taken to the next level with root pass productivity increases of up to 55% and industry-leading arc stability.
- Smart PulseTM, which is tailored for using pulsed GMAW/FCAW/MCAW on pipe. Smart Pulse uses Lincoln Electric's Waveform Control Technology®, which monitors the machine settings and automatically tailors each pulse to deliver the ideal arc for the instantaneous pipe welding needs. Low wire feed speeds can be set for out-of-position pipe welding and Smart Pulse auto-adjusts deliver a narrow, focused arc. And when high wire speeds are set for 1G pipe welding, the system auto-adjusts for a wide, soft arc. This results in more productive time for the completion of weld joints.
- The PIPEFAB system comes fully loaded with welding modes optimised specially for the needs of pipe and vessel fabrication. All processes – Stick, MIG, TIG and FCAW –have been fine-tuned for maximum performance with the industry's common filler metals, wire diameters and gas mixtures. Stick modes for cellulosic and low hydrogen electrodes are included and MIG modes optimised for all common wire sizes for steel, stainless steel and metal-cored wires.

Lincoln Electric's PIPEFAB welding system delivers an optimised setup for pipe and vessel fabrication.

"These and many other features make PIPEFAB an ideal choice for those wanting to take welding productivity and quality to the next level," concludes Mngomezulu.

www.lincolnelectric.com/en-za

LIBS versus X-ray spectroscopy

Lyndon Momberg, SciAps Product Specialist for the NDT equipment specialist, Gammatec, talks about modern spectroscopes for analysing the concentrations of different elements in various metal alloys. He compares laser-based (LIBS) and X-ray based systems and highlights the advantages of each.

LIBS is an acronym for Laser Induced Breakdown Spectroscopy. These handheld analysers use a high-focused laser to ablate the surface of a sample. This results in a plasma being formed that consists of electronically excited atoms and ions. As these highly excited atoms 'decay' back into their ground states, they emit characteristic wavelengths on the electromagnetic spectrum that relate directly to the composition of the alloy being tested.

This makes handheld LIBS analysis an excellent tool for quickly and easily identifying the exact composition or grade of a metal alloy.

X-ray spectroscopy or X-ray fluorescence spectroscopy uses X-rays to excite the surface of the metal being tested. These excite the atoms of the material, causing high-energy photons to be emitted from each element. By analysing the energy associated with each of the emitted photos, individual elements and their percentage composition can be identified.

The analysis techniques have different strengths and weaknesses when it comes to individual alloying elements, so for best results it becomes important to use the most suitable type of analyser for the specific alloy of interest.

Testing aluminium

Historically X-ray has performed poorly on aluminium alloys. However, the SciAps X-250 features an advanced X-ray tube technology and an aluminium analysis algorithm that can separate 90% of all aluminium alloys within 2.0 seconds and identify the remaining 10% within 4.0 seconds.

In addition, the focus has been put where it needs to be: magnesium (Mg) and silicon (Si) analysis.

With respect to lithium (Li) however, LIBS analysers can measure lithium concentrations, but X-ray systems cannot. Also, nearly every aluminium alloy with lithium also contains silver (Ag), which is added together with the lithium. X-ray analysers can all measure silver, which can be used as an indicator for lithium in lithium-containing aluminium alloys. If you see Ag in aluminium, it is highly likely that Li is there as well.

Analysis of red metals

LIBS can measure aluminium and silicon content and silicon bronzes in a single fast test. The SciAps X-250 can now measure typical levels of silicon and aluminium in bronzes in 1 to 2 seconds. Testing time is therefore 3 to 4 seconds if the silicon and aluminium concentrations are included, and 1 to 2 seconds if excluded. The X-250 software automatically determines if the material is an aluminium or silicon bronze and extends the test. The X-250 performs the most efficient test.

What about beryllium? The SciAps LIBS analyser can measure beryllium in a red metal, while X-ray-based systems cannot. Cobalt, however, is an indicator element for beryllium in copper alloys. If cobalt is measured in a copper alloy, beryllium will be present as well – and cobalt is easily measured using X-ray analysis.

If using cobalt as an indicator for beryllium copper alloys, then the X-250 is a better choice for general red metal sorting. If measuring beryllium in the copper alloys; lithium in aluminium alloys; boron in nickel, stainless or ferrous alloys; or carbon in anything, however, then the SciAps LIBS systems are the better choice.

Options for ferrous and stainless steels

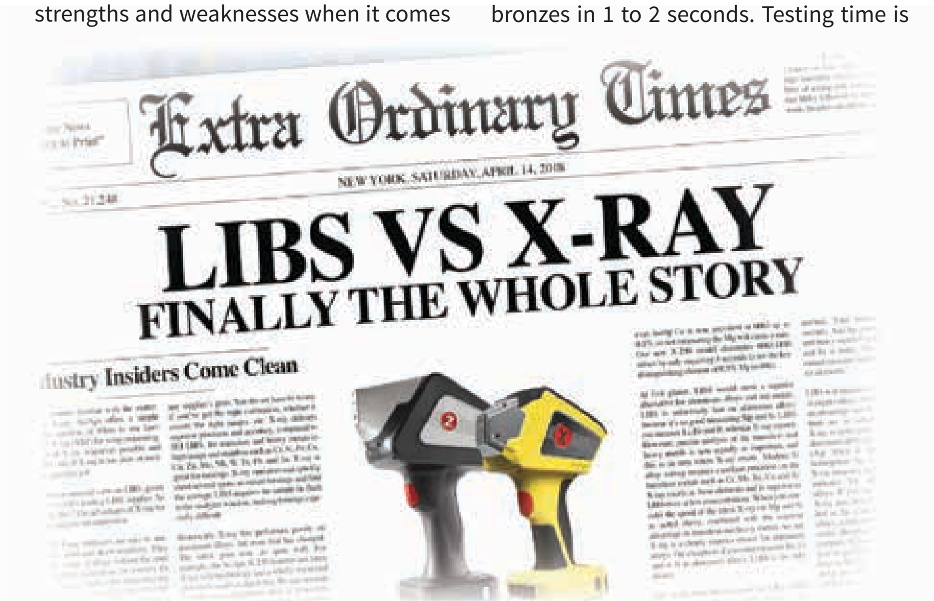
Material processors and fabricators dealing with steels tend to use LIBS analysers to sort carbon steels by carbon content, a great application for the argon-purged SciAps Z 200 C+ LIBS analyser, which is the only handheld analyser that can identify carbon content. LIBS analysers are also able to segregate cast and ductile irons by magnesium content, while X-ray systems cannot measure these low levels of magnesium.

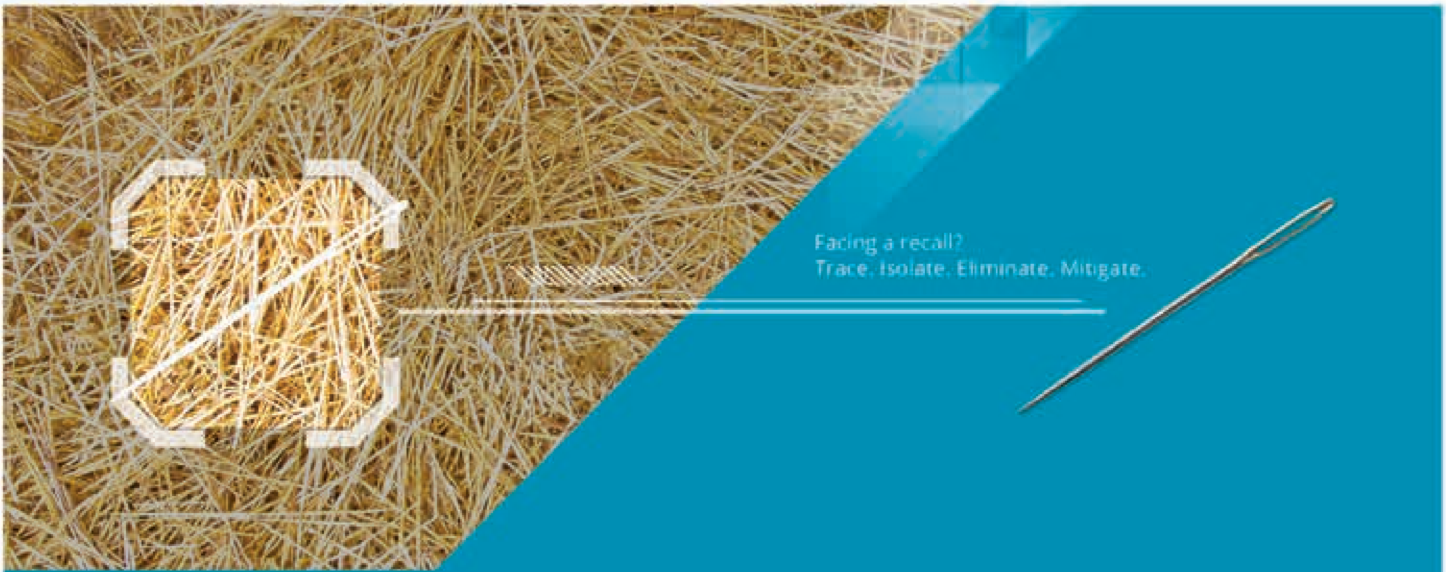
In conclusion, the SciAps X-250 plus X-ray based analyser with the aluminium app will deliver exceptional performance on aluminium alloys. But for many specialty applications mentioned above, LIBS is an excellent alternative handheld technology.

Gammatec's view on the interplay between LIBS and X-ray is therefore easily stated: Use LIBS if you need one of the specialty applications described here. In all other cases, X-ray is the better option.

Or in a single line: use X-ray wherever possible, and LIBS if X-ray cannot do the job.

www.gammatecsa.com





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