Fusion

SAIW 1948 – 2018

Newsletter of the Southern African Institute of Welding

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Special 2018 Annual Awards Edition

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Welcome to the special Awards edition of Fusion

This year we celebrate the SAIW's 70th anniversary and consequently this year's Awards, which took place at our 70th Annual Dinner, took on a special significance.

It is important to note that while it is always great to be a winner – and the standard of the winners was, as always, world class – the standard of all the nominees was exceedingly high. It was, and in our industry always is, difficult to choose the ultimate winners.

This is, of course, something to celebrate! To have an industry where the standards of excellence are high across the board is something we can all be proud of.

> **'THIS IS, OF COURSE, SOMETHING TO CELEBRATE! TO HAVE AN INDUSTRY WHERE THE STANDARDS OF EXCELLENCE ARE HIGH ACROSS THE BOARD IS SOMETHING WE CAN ALL BE PROUD OF.'**

This year we introduced two new Awards, Best Responsible Welding Coordinator Award and Best IIW Manufacturing Certification Company Award. These are vital areas of our industry and I hope these Awards help to ensure the exceptionally high standard we have in our country for years to come.

But it's not only the Awards we celebrate at this time! It is also an apt time to celebrate the SAIW's achievements.

Starting with this past year, a team of five SAIW welders sponsored by the MerSeta, participated with 36 countries in the third Arc Cup in China and finished the competition in the bronze category. Of the group of five South African competitors, three were females which represented the largest group of females in the competition with a total of only seven females competing.

Last year the SAIW Foundation – a public benefit organisation, started by the SAIW to provide training to disadvantaged individuals in a wide range of welding and related areas – trained a group of six students on the International Welder programme in partnership with the ArcelorMittal Science Centre in Sebokeng. The group achieved excellent results and showed exceptional talent.

For the next SAIW Foundation project we plan to train 15 students on a QCTO Artisan Welder Apprenticeship programme, once again in partnership with ArcelorMittal. This project is aligned to the Centres of Specialisation project on which we are working with the Department of Higher Education and Training in order to equip the TVET training colleges with the necessary skills to train artisan welders.

SAIW is in the process of developing our Future Welder Training Centre. The first machines that will be used in the new SAIW Future Welding Training Centre are the Lincoln Electric Real-Weld and the Soldamatic Augmented Reality Welding Simulator. Augmented welder training allows students to work with real 3D objects combined with virtual computer-generated images to give them the most realistic welding experience possible. We will also be starting robotic welding training thanks to generous sponsorship from Yasakawa.

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Welcome to the special Awards edition of Fusion *Continued from page 1*

On the courses front, the IIW International Welding Inspector programme continues to develop and we will be offering this programme on all three levels next year. We have trained approximately 125 students from Hydra-Arc / Jomele on the IIW Welding Inspector course in the past year with 40 currently in progress. We are extremely grateful for this training opportunity.

We have also recently completed training Sasol Group G on a full suite of SAIW courses and we look forward to doing Group H next year. In terms of the IIW Welding Coordination training programme, we qualified 117 personnel last year which represents a 39% increase over the prior period.

Our ISO 3834 Certification Scheme continues to go from strength to strength and we currently have 168 companies listed on the register. We have also completed the ISO 17021 accreditation from SANAS and expect SANAS to issue the certificate shortly.

Finally, I must say that I was astounded at the response to our 70th Annual Dinner. In spite of tough trading conditions in the industry, we managed to fill 42 tables and 10 companies agreed to sponsor the function. Thanks to you all.

Sean Blake

All the 2018 Awards

Institute Gold Medal Award for 2018

The Institute's Gold Medal Award, introduced in 1966, is the SAIW's highest Award and is made to a company or an individual in recognition of outstanding contributions to welding technology or to the Institute.

The nominees for the SAIW Gold Medal Award were:

Babcock Matla. The nomination was for Babcock Matla's exceptional delivery of quality and efficiency. Over the years Babcock Matla has explored multiple avenues to facilitate optimal customer satisfaction. These avenues have included, inter alia, technical studies and internal system adaptations. The innovations included strategic pre-heat methods, a conversion from traditional 2% thoriated tungsten to 2% ceriated tungsten electrodes, review of internal systems to include detailed analysis of all weld repairs by both welders and welding supervisors. These initiatives resulted in the weld repair rate decreasing from 7.2% to 2.5% in their last financial year. In the last General Outage of Unit 1 at the power station, 10 000 butt welds were completed with a variety of materials with old to new connections, a weld repair rate of 1.7% was achieved for all welds done in the boiler – a phenomenal achievement.

Grietjie Doubell and children receiving Philip's Gold Medal Award

Philip Doubell. The late Philip Doubell was a dedicated contributor to the welding industry making many valuable technical contributions and providing inspiration and mentorship to all those who crossed his path. A key focus of Philip's work at Eskom was life extension of plants with varying welding technologies and he achieved notable successes at Koeberg Nuclear Power Station and the Hendrina Power Station.

Philip worked closely with Prof Danie Hattingh and was a co-inventor of the WeldCore technology. To a large degree it was his inspiration and dedication that ensured the success of the project, particularly the industrial application and commercial readiness of the WeldCore technology.

Philip made valuable contributions to the industry at large and particularly to Eskom, his employer by publishing and presenting many technical papers. He is cited as publishing 22 research papers on ResearchGate having co-authored many papers with leading international academics as well as industry stalwarts.

Philip would also gladly present his research work and technical papers at SAIW conferences and technical evening meetings and was awarded the Harvey Shacklock Gold Medal Award in 2006 for his paper titled "Weld refurbishment of heavy walled components, hydro-penstock repair".

Philip lead the way in the founding of the International Welding Engineer qualification programme which was initially offered by the University of the Witwatersrand, and was part of the first group to be trained on this qualification programme.

For 2018 the Award was given posthumously to Philip Doubell in "recognition of his dedication as a Welding Engineer, who inspired and developed welding technologies, which made significant contributions to the industry at large."

Philip's wife Grietjie, accompanied by their son and daughter, received the Award on Philip's behalf.

SAIW PRESIDENTS' AWARD FOR NDT

Most people will not appreciate that SAIW has been training NDT personnel for more than 40 years – the same period of time that SAIW has offered training in welding. NDT is a very important part of the Institute's programmes and we want to encourage more young people to enter this field which offers good career opportunities.

The SAIW Presidents' Award recognises the top NDT student on Institute courses and is made in the name of the past Presidents of SAIW who have helped guide the Institute to not only become a vital part of the local welding industry but also to be South Africa's reference point for high quality training in welding and NDT training.

This year, the SAIW Certification Governing Board gave this Award to two recipients:

Bronwyn Nadene Geel (for achieving distinctions in Magnetic Testing Levels 1 and 2; Penetrant Testing Levels 1 and 2; Visual Testing Level 1; Ultrasonic Wall thickness Testing, Ultrasonic Testing Level 1 and Radiographic Interpreters Level 2.

Bronwyn Nadene Geel – SAIW Presidents' Award for NDT

To emphasise Bronwyn's achievement, during the initial examination for Ultrasonic Level 1 she achieved an average of 88% and in Radiographic Interpreters, which is the most difficult method to pass, she achieved an overall average of 91% during the initial examination.

Collen Morithinyana Tseke – SAIW Presidents' Award for NDT

Collen Morithinyana Tseke (for achieving distinctions in Magnetic Testing Levels 1 and 2; Penetrant Testing Levels 1 and 2; Visual Testing Level 1; Ultrasonic Wall thickness Testing, Ultrasonic Testing Level 1 and Radiographic Interpreters Level 2.

To emphasise Collen's achievement, during the initial examination for Ultrasonic Level 1 he achieved an average of 92% and in Radiographic Interpreters, which is the most difficult method to pass, he achieved an overall average of 82% during the initial examination.

Phil Santilhano Memorial Award

The Phil Santilhano Award, which is presented to the best student on the Institute's courses in Welding Supervision and Inspection, is named after the man who was one of South Africa's leading welding technologists and is best remembered for the ground-breaking work he did whilst employed by Vecor on Submerged Arc and Electro-Slag welding of heavy wall pressure vessels.

Santilhano became the Institute's first full time employee when he was appointed Technical Director in 1977.

Chane Marais – Phil Santilhano Memorial Award

This year's winner was **Chane Marais** who achieved the highest mark for the SAIW Welding Inspectors Level 2 programme.

Harvey Shacklock Gold Medal Award

The Harvey Shacklock Gold Medal Award is made to the author of the best technical paper presented at an Institute or IIW event.

Harvey Shacklock was the Managing Director of BOC (British Oxygen Company) now known as Afrox. He was instrumental in founding the Southern African Institute of Welding and was the President when it was founded on 1st March 1948, 70 years ago.

This Award was named in memory of his contribution to the welding industry and it was first presented in 1949. Afrox, part of the worldwide Linde group, generously donates a gold medal for the Award.

Kristian Kruger (left) – Harvey Shacklock Gold Medal Award

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2018 Awards

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This year's Award went to **Kristian Kruger** for his presentation "Cold repair of Inconel 625 clad layer on medium carbon high strength steel". The paper was co-authored by Frederic Laurent of 3C Metal and Pieter Pistorius from the University of Pretoria – both of whom received certificates in acknowledgement of their participation in the paper which was presented at the International Institute of Welding Annual Assembly Commission 2 in Indonesia (Bali) in 2018.

Best IIW Manufacturing Certification Company Award

Kelvion Thermal Solutions – Best IIW Manufacturing Certification Company Award

This Award, introduced for the first time this year, is made in recognition of a company that has excelled in the ISO 3834 Certification Manufacturing scheme by demonstrating excellence in the implementation of a welding process control system.

The nominees for this Award were:

Actom John Thompson is a leading designer and manufacturer of industrial boilers and associated plant whose name is synonymous with well-engineered boilers. As well as related products incorporating heat transfer technology, Actom also designs, supplies, installs and retrofits new and existing environmental equipment and provides boiler service and maintenance for Eskom's coal-fired power stations.

Aveng Grinaker-LTA Mechanical and Electrical is a market leader in providing fabrication, construction and maintenance services for process plants in the oil & gas, petrochemicals, minerals processing, desalination, renewable energy, chemicals, steam generation, power and allied industries. Specialist divisions within the group provide services for capital projects, turnarounds, shutdowns, and plant maintenance.

Gascon is a manufacturer of pressure vessels for the petro-chemical, power generation and off-shore industries as well as storage vessels for the transport industry. The company has an impressive range of certifications in addition to the ISO 3834 which includes the ASME U and R stamps, National Board, Chinese SELO certification, DNV Pressure Vessel Certification, European Pressure Equipment certification to PD 5500, EN 13485 and EN 13530 as well as European Road and Rail for Dangerous Goods Certification.

Hi-Tech Pressure Engineering designs and manufactures code compliant pressure equipment and related plant with customers in a wide range of industries. Products include storage and process vessels, as well as piping systems that qualify as pressure equipment.

Kelvion Thermal Solutions services a wide range of industries specialising in the manufacture of heat exchangers, pressure vessels and process equipment. Kelvion has extensive knowledge and experience in the design and manufacture of this equipment and leads the way with innovative development and implementation of technologies having registered patents for these technologies.

Vessel Fabrication specializes in the manufacture of pressure vessels, storage vessels, shell & tube heat exchangers which are used throughout South Africa and abroad in a number of industry sectors including mining, precious metals & base metals, refineries, petrochemical, food & beverage, defence & munitions, water treatment & purification and the cosmetics industry.

This year's winner was Kelvion Thermal Solutions.

Best Responsible Welding Coordinator Award

This Award, also introduced for the first time this year, is made in recognition of an exceptional welding Coordinator for the IIW Manufacturing Scheme responsible for the implementation and maintenance of the welding processes and the welding quality mangement.

The nominees for this Award were:

Lorien Chettiar – this year's winner, Quality & Responsible Welding Coordinator at Aveng Grinaker LTA

Angel Krustev, Manager for Welding and Quality Assurance at Kelvion Thermal Solutions

Eric Lemmer, Quality Manager at Manlimeli Projects and Fabrication

Ravika Ramnath, QC and Welding Coordinator at SHM Engineering

Jacques Venter, Quality Manager and Welding Engineer at GRW Engineering

Tiaan Vosloo, Divisional Welding Engineer and Responsible Welding Coordinator at Actom, John Thompson.

Lorrien Chettiar – Best Responsible Welding Coordinator Award

Judging criteria for Best IIW Manufacturing Certification Company Award and Best Responisible Welding Coordinator Award

As this is the first year that these Awards have been instituted, the SAIW felt it was important for Fusion readers to understand what the criteria are for judging the best candidates. These are found below.

Best ISO 3834 Manufacturing Company

1. Meeting the requirements of the ISO 3834 scheme. Score from assessment.
2. Revision of audit documentation. Level of compliance of ISO 3834, number of non conformances from last assessment.
3. Implementation and involvement of the management team of the quality process.
4. Commitment and achievement of continuous improvement of the welding process management systems to achieve required quality levels.
5. Production of high quality product.
6. Degree of customer satisfaction.
7. Certifications held by third party certification bodies.
8. Innovative products manufactured using welding technologies.
9. New markets developed for supply of products.
10. Welding Coordination team – Depth of knowledge, qualifications and experience.
11. Company has an effective system to manage weld defect rate effectively and implements processes to prevent weld defects on the shop floor.

Best Welding Coordinator

1. Achievement in implementation of quality management and welding processes.
2. Qualifications attained in respect of welding coordination.
3. Dedication to quality of welding.
4. Achievement of tasks and responsibilities of the welding coordinator within the organisation.
5. Attainment of technical knowledge.
6. Level of innovation in terms of implementation of welding processes and quality management systems.
7. Implementation of new welding technologies and innovation in respect of welding technologies.
8. Development of welding coordination team. Mentoring and transfer of knowledge to members in the welding coordination team.
9. Monitors and manages weld defect rate effectively and implements corrective action to prevent weld defects on the shop floor.

All the nominated candidates were of a high quality and were deserving of the nominations. As a result it was a tough task to choose a winner as there were so many deserving candidates. However, based on the scoring criteria, there were two clear winners even though it was neck and neck with the scores being in a particularly narrow band – Sean Blake.

2018 Awards

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Annual Dinners – commemorating 70 years of success

The Annual Dinners are always a milestone in SAIW's year... and a lot of fun. This year was special as it was our 70th Annual Dinner and the quality of the award winners, the quality of the entertainment and the vibe in general, both in Cape Town and in Johannesburg, were expressions of what has been an incredible 70 years of success.

NDT – A Very Viable Career Choice

The latest figures released by Statistic SA in July 2018, indicated that the current unemployment rate in South Africa is 27,2%, and the percentage of young persons aged 15–24 years who were not in employment, education or training is a staggering 31,6%.

So, in these times of economic uncertainty, finding something that will almost certainly get you a job is obviously worth its weight in gold!

Well, a course at the Southern African Institute of Welding (SAIW) could just be that 'something' as more than 75% of those who complete an SAIW course – and this includes Non-Destructive Testing (NDT) courses – do find sound and stable employment.

There are, however, those who say that with the large Eskom new build projects drawing to a close and the struggling State-owned Enterprises (SOEs) cutting down on maintenance programmes in an effort to save operating costs, the scope of inspection and test activities are seemingly diminishing.

But Harold Jansen, SAIW Systems and Quality Manager, remains positive. "Promoting NDT might be one of the best strategies to help resolve these low employment figures since the access conditions are relatively low. For example, a Grade 10 certificate with mathematics and science is required for access to surface testing methods; and the training, qualification and certification period prior to being employed and earning an acceptable salary, can be as low as 2 months, keeping in mind that the salary shall increase as the competence and marketability of the individual increase via continuous personnel training, qualification and development," he says.

He adds that, in addition, NDT is somewhat of a local priority. "NDT has been listed as a scarce /critical skill since 2014 and 'localisation' thereof is encouraged via the National Skills Development Plan. NDT remains a prominent item on all qualification levels, being categorised under three of the 12 educational subject matters namely: Engineering, Life and Earth Science and Professionals and Associate Professionals."

The SAIW NDT department is certainly playing its part to promote NDT as a career by ensuring the highest standards with its initiation of the National NDT Capability (NNDTC) project, a five-year multi-faceted campaign, supported by SAIW Certification, the ISO 17024 SANAS accredited personnel certification body and directed by the SAQCC-NDT Scheme Committee, the National NDT Qualification and Certification scheme.

The objective of the NNDTC project is to define, determine and improve the quality of Non-Destructive Testing in South Africa by addressing the following aspects:

1. Define and determine the national NDT Infrastructure
2. Competence of NDT personnel
3. Quality systems and documentation
4. Inspection methodology
5. Inspection validation

Jansen says that doing all that one can to ensure the highest levels of professionalism is apt at this time for budding NDT practitioners. "Even if the demand for competent NDT personnel has slowed slightly in South Africa, the global market continues to grow and there are significant shortages of personnel on the African continent. A competent NDT individual could therefore easily participate in regional industries not linked to the local national demand. "

So there are definitely career opportunities for competent NDT personnel coming out of the SAIW and, looking into the future, considering the national NDT workforce, a third of it is over the age of 41 with only 14,5% consisting of females. Significant growth within this occupation can therefore be anticipated once the economic challenges are resolved and we will be investing in NDT training and development because it is a wise strategy," Jansen says

All being considered, and based on a conservative estimate, an annual demand of 300 new competent NDT personnel entering the market should be sufficient to service the national need, but should South Africa aim to become a global exporter of NDT expertise then this number can, and should easily increase to a 1000 or more.

With respect to the true value of NDT one should not only consider the cost of implementing it but rather at the savings over the life-time of a plant through, inter alia, the following:

- continuous monitoring of plant components,
- saving due to preventative maintenance,
- prevention of a dramatic failure and possible loss of life,
- remnant life prediction and
- replacement planning.

"Also," concludes Jansen, "the value of NDT is also the contribution it makes to the NDT technician's family and community. It is up to all of us to ensure the viability of our own particular specialities in order to help turn around the challenging economic environment that currently exists in South Africa," Jansen concludes.

Focus on Courses

The SAIW is continuously looking to provide the market with courses that are pertinent to the ever-changing conditions in the welding industry. The following two courses answer specific needs confronting our industry at the present moment.

Piping Inspectors Course

The South African Pressure Equipment Regulations (PER) requires that new and in-service pipelines are categorized and conformity assessed in accordance with SANS 347. SAIW has for a long time offered courses that lead to certification as a Competent Person (CP) for In-Service Inspection as well as for Inspector of Pressure Equipment (IPE) certification for all new construction and repairs through the respective SAQCC schemes. A need has now been identified for the certification of Pipeline Inspectors.

This new Piping Inspectors course is based on certification requirements similar to the Competent Person and Inspector of Pressurised Equipment, consisting of a one week theoretical course, followed by an examination. The candidate is then required to gather experience as a pipeline inspector prior to application for certification.

It is also a requirement for the inspector to have comprehensive knowledge of the South African legislation for Pressure Equipment, therefore it is a pre-requisite for the student to have successfully undertaken a Legal Knowledge course on the PER and SANS 347.

Successful candidates will have comprehensive knowledge on the requirements of International Pipeline and Piping Component Inspection standards, including failure mechanisms, safety devices,

the requirements for new construction standards, and Inspection techniques followed by objective and supportive report writing.

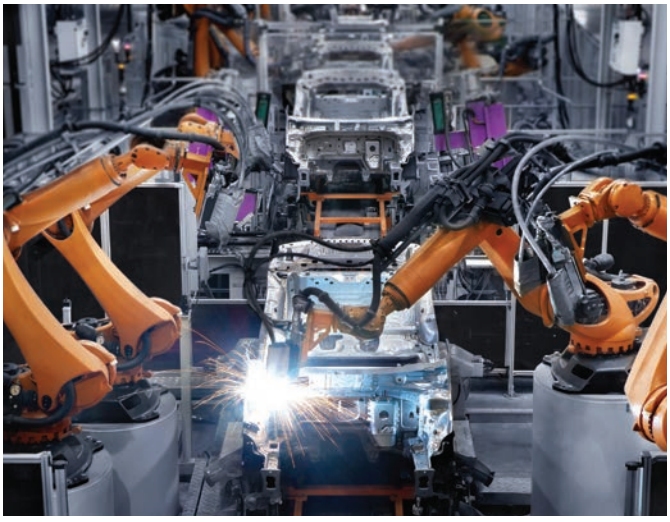
Among others, the following International standards will be covered API 570, API 571, API 574, API 576, API 579, and ASME B31.3 and ASME B16.5 construction standards.

International Robotic Welder

The International Robotic Welder training course is designed to give the candidate the necessary theoretical knowledge on welding technology by equipping him/her with the skills to manage all aspects of a robotic welding operation including design of the welding task, safety and troubleshooting of the welding operation.

The course gives the candidate an understanding of the following aspects of Robotic Welding (RW):

- Terminology used for RW.
- The different levels of automation, mechanization and robotic welding.
- The quality assurance, quality control and inspection applied in RW.
- Productivity and economics of welding.
- Non-Destructive Testing of Robotic Welds.
- Technical drawings including interpretation and application.
- Welding Symbols.
- Standards for welding defects (ISO 5817).
- Health and Safety in RW.
- RW Systems and Programming.
    - Axes of RW Systems
    - Control Systems in RW
    - Structure of Welding Systems
    - Equipment components used in RW
    - RW Programming and Efficient Use.
    - Welding Processes used in RW



    - Programming of Robots
    - Seam tracking systems and sensors used in RW
    - Joint Preparation for RW
    - Maintenance of RW Systems

The training includes a practical module which will teach the Welding Operator

- Welding procedures
- Qualification tests of the RW Operator as per ISO 14732
- Programming of the RW Machine including off-line programming

In the SPOTLIGHT

NATASHA VENTER

AS USUAL, FUSION TALKS TO SOMEONE WHO HAS MADE A SIGNIFICANT CONTRIBUTION TO THE WELDING INDUSTRY AND/OR TO THE SAIW. THIS TIME WE FEATURE NATASHA VENTER, BU QUALITY & WELDING MANAGER AT AVENG GRINAKER-LTA MECHANICAL & ELECTRICAL. SHE HAS MADE A PARTICULARLY STRONG CONTRIBUTION IN HER FIELD AND TO HER COMPANY, WHICH THIS YEAR WON THE BEST RESPONSIBLE WELDING COORDINATOR AWARD AT THE SAIW 70TH ANNUAL DINNER. BORN 8 AUGUST 1972 IN EAST LONDON NATASHA IS "BLESSED" TO BE MARRIED TO A "VERY SUPPORTIVE" KOBUS VENTER AND THEY HAVE ONE CHILD, DYLAN (21) AND TWO FUR BABIES, JESSIE (10) AND STORM (2).

F: How did you get involved in the welding industry?

NV: I was one of only three girls that matriculated in 1990 – times have changed – from the Technical High School in Sasolburg and coming from a large family, my parents did not have funds to send me to study further so I started working as a pharmacy assistant after I left school.

Eight years later, in June 1998, I was given an opportunity to work at Moody International to process the documentation relating to the qualification of welding procedures and this is where my long association with the welding industry began.

I spread my wings and five years later in January 2003, to gain petrochemical experience, I joined NATREF Refinery as a Senior Welding Inspector where I worked for four years.

F: Did you start with Aveng after NATREF?

NV: Yes. I was approached by DSE (also known as Aveng Steel Fabrication) in 2007 for the position of a QA/QC Manager in the fabrication workshop located in Vanderbijlpark, which I took up. In 2010 I completed my Quality Engineering Diploma through SQMI with the course affiliated with City & Guilds. During my time at DSE, I was responsible for ensuring that the company obtained certification to ISO 3834 Part 3, which they did in 2010.

F: Is it correct that you have had some nuclear experience?

NV: Well, when Aveng Group established its Nuclear division, I was approached to join them in 2012 as the Quality Manager. I was part of the team that successfully established a QHSE system certified to ISO 9001:2008 and which complied with the requirements of RD 0034 (National Nuclear Regulator requirements for Quality and Safety Management for Nuclear Installations) and NSQ-100 (Nuclear Safety & Quality Management Systems). Due to the challenging economic climate in the country and the continued uncertainty of when or if the new build would commence, the nuclear division was closed in 2015.

F: What happened then?

NV: Mike Turnbull (SHEQ Executive) for Aveng Grinaker-LTA Mechanical & Electrical took me under his wing and I got involved with the welding system that was established based on the requirements of ISO 3834 Part 2. As the company underwent restructuring based on business needs, I am currently the Quality and Welding Manager for the company and I ensure the full implementation and continuous improvement of the ISO 9001 and ISO 3834 certifications.

F: What do you think of the standard of welding in South Africa and of the SAIW?

NV: The standard is very high and the SAIW plays an important role in maintaining these excellent quality levels. As a leading training organization, the SAIW also empowers and provides opportunities for the youth who seek a career in welding. The focus needs to remain on skills development in all the welding related disciplines. The fact is that welding is the backbone of infrastructure development in any country and the SAIW is central to ensuring the optimal working of the welding industry as a whole in our country.

F: Are you directly involved with the SAIW in any way?

NV: In March 2018, I was honoured to be nominated to chair the ANBCC Board (SAIW Certification Welding Fabricator Board). These are huge shoes to fill, as previous Chairman, Peter Viljoen, has made a huge contribution to the welding industry with his association with the SAIW over the years.

F: What do you do to relax?

NV: I try to take a weekend break-away with my husband at least once a month to try and balance the stresses of work. My favourite place in South Africa is the KwaZulu Natal Midlands. When time allows, I enjoy reading, building puzzles, crosswords, sudoku, cake decorating and I love cooking.

F: Thanks Natasha. Good Luck

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Ultrasonic Examination Part 1

Ultrasonic examination uses the same principles as the sonar used for the detection of submarines – a sound wave is emitted from a transmitter, bounces off any objects in its path and is reflected back to a receiver, somewhat similar to shining the beam of a torch at a mirror. Knowing the speed of sound in the material enables the distance of an object to be determined by measuring the time that elapses between the transmission of the sound pulse and detection of the "echo". In welded components the examination is generally performed by moving a small probe containing both a transmitter and receiver over the item and displaying the echo on an oscilloscope screen. This is shown in Fig. 1 which illustrates a simple pulse-echo angle probe examination.

The oscillator sends pulses of electricity to a piezo-electric crystal, the pulse generator, embedded in the ultrasonic probe which causes it to vibrate at a very high (ultrasonic) frequency, well above any audible frequency and typically between 1Mega Hertz(MHz) and 15MHz. Ultrasonic probes used for weld examination have frequencies generally between 2MHz and 5Mhz, the lower frequency probes being used for the examination of coarse grained material or on rough surfaces, the higher frequency probes for the detection of fine defects such as cracks or lack of fusion. The ultrasonic vibrations are transmitted into the material to be tested using a "couplant" such as grease, paste or water which helps transmission of the vibrations. The better the surface finish then the better is the coupling and the more searching the examination – hence there is sometimes a requirement to grind smooth the weld cap and remove the root penetration bead on welded joints.

Once in the material the vibrations travel in a predictable path as a beam of sound pulses until they encounter an obstruction or interface such as a line of slag, porosity or a crack when most of the sound will be reflected – remember the analogy of the torch and mirror. Depending on the angle at which the beam strikes the obstruction some or all of the sound beam will be reflected back to the receiver in the probe. Here it vibrates a piezo-electric crystal; the electric signal that is generated is amplified, rectified and displayed on an oscilloscope screen.

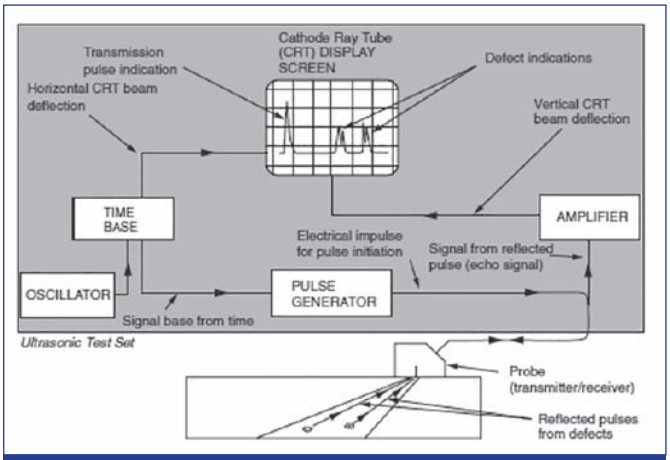

Fig 1. Schematic of Angle Probe Ultrasonic examination.

The sound beam when it enters the object being scanned has a cross section approximately that of the transmitter but, like the beam of a torch, will diverge as shown in Fig. 1. As the beam travels through the material it also loses energy – it becomes attenuated. These effects need to be taken into account when the position and size of a defect is to be accurately determined.

The oscilloscope screen in Fig. 1 shows on the vertical axis the signal height or amplitude and on the horizontal axis the time taken for the signal to return to the receiver and therefore distance from the transmitter. This method of examination is known as an "A scan" and is the most common method in use in industry for the examination of welded joints. In Fig 1 three signal peaks can be seen on the oscilloscope screen – one where the signal enters the sample, one reflected from the back face of the sample – the "back wall echo" – and, between the two, a reflection from some feature – a "reflector" such as a welding defect. The distance of this signal on the screen from the transmission pulse will give the distance of the reflector from the probe so a little simple geometry can be used to calculate the position and depth of the reflector within the block of material. Comparing the height of the signal with the signal from a known size of reflector enables the size of the feature to be determined.

There are two main types or modes of sound waves – longitudinal or compression waves which alternately compress and decompress the material in the direction of propagation and shear waves which vibrate the material at right angles to the direction of propagation. Which mode is produced depends upon the angle at which the sound beam enters the material. Probes that project the beam into the test piece at an angle normal (90degs) to the plate surface are known as compression probes and are ideally suited to the detection of defects such as plate laminations or for the measurement of plate/pipe thickness as shown in Fig 2.

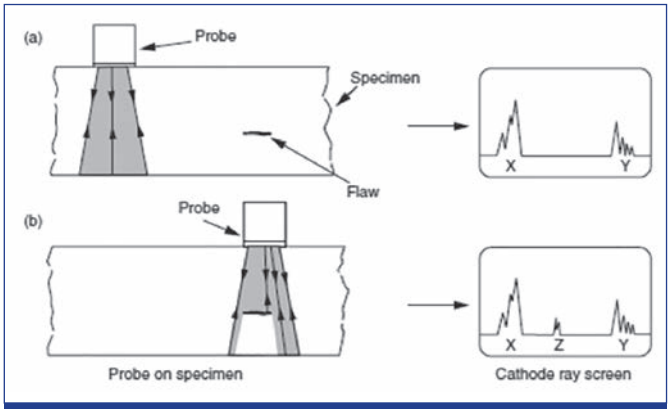

Fig. 2. Compression Wave Probe

To obtain the strongest reflected signal the beam should ideally strike the feature at 900 – flaws that lie parallel to the beam may be missed. This means that to examine a weld that may contain flaws laying in any number of orientations within the weld a range of different angle probes and scanning patterns must be used. To do this both compression and shear wave probes may be used, shear wave probes projecting the beam into the test piece at an angle, as shown in Fig. 1. Probes with angles of 30°, 45°, 60° and 70° are commercially available. Examples

of standard probes are illustrated in Fig. 3.The angle of the probe is often selected to give the strongest signal from the defect of interest and for very high integrity welds all five probe angles may be used.

Fig 3. A 2.5MHz 70 degrees shear wave probe and a compression wave probe.

As shown in Fig. 4 the sound beam can be made to scan the full depth of a weld by moving the probe back and forth. At the half skip distance the beam would readily detect lack of side wall fusion along the left hand fusion line but may miss lack of side wall on the right hand fusion line. Moving the probe to the full skip distance so that the beam reflects off the back face enables the right hand fusion line to be scanned with the beam at the optimum angle to detect lack of side wall fusion.

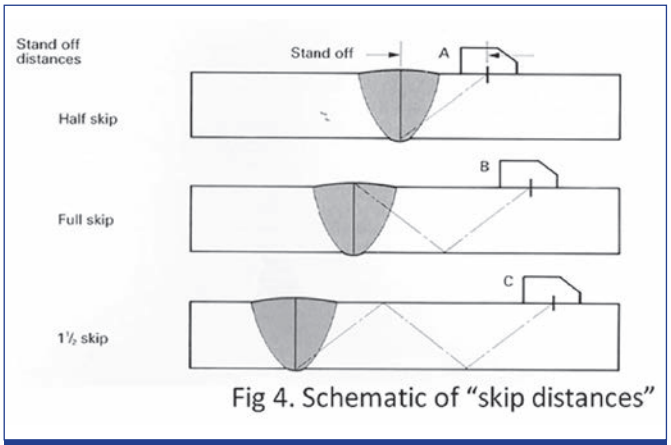

Fig 4. Schematic of "skip distances"

To examine completely the weld there needs to be a number of such scanning patterns longitudinal and transverse to the weld, from both sides of the weld, from both plate surfaces and from half to full skip distance. If all of these scans are carried out using all five probe types and two frequencies then it becomes a very lengthy and costly exercise! Such detailed examinations tend to be confined to items such as primary circuit nuclear components and highly critical offshore applications.

Whilst many ultrasonic examinations are carried out with a manual operative moving the probe, viewing the results on the oscilloscope screen and manually recording the results the process can be mechanised with the probes mounted on a carriage and the results recorded electronically. This has become more prevalent as computing power has increased since the carriage may carry several probes and provides information on the carriage position and orientation. This data is then analysed and compared with an acceptance standard, enabling a weld to be sentenced automatically .

There are a number of advantages to ultrasonic testing:-

1. It is very good – and better than radiography – for the detection of planar defects such a lack of fusion and cracks
2. It can determine both the depth and position of defects.
3. It is readily portable and easy to use on site and in areas of restricted access.
4. Access is required to one side only.
5. There are none of the health and safety problems associated with radiography.
6. The result is immediately available.

But, as with any industrial process there are some disadvantages:-

1. Very skilled and conscientious operatives are required .
2. The manual examination process is slow, laborious and tiring for the operative.
3. Surface breaking defects are difficult to detect.
4. Accurate sizing of small (<3mm) defects is difficult if not impossible.
5. The root region in a single sided full penetration weld is difficult to interpret.
6. The geometry of the joint can restrict the scanning pattern and impede accurate interpretation.
7. Interpretation is subjective and depends upon the operative's skill and experience.
8. With manual scanning no permanent and objective record is produced.

The A-scan mentioned above is one method for reporting the results of the scan – there are in fact four methods identified as A-, B-, C- and D-scan. The A-scan method is the conventional way of presenting the results – signal amplitude vs distance; B-scan is a view looking along the length of the weld; C-scan is a plan view and D-scan a view from the side of the weld. These are illustrated in Fig.5

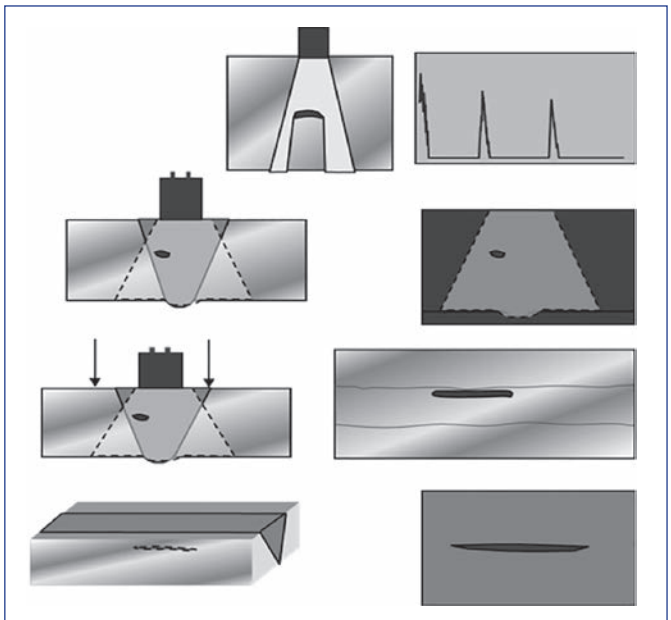

Fig 5 Schematic of A-, B-, C- and D- scan results

This article was written by Gene Mathers.

An Introduction to Guided Wave Technology

Global leader in the development and manufacture of guided wave solutions

Introduction

There has been quite an interest in Guided Wave Technology of late and Fusion invited well-known supplier, Guided Ultrasonics, to explain the technology.

Established in 1999, Guided Ultrasonics Ltd. (GUL) has been at the forefront of guided wave technology for pipe testing. Since then, the company has led the way in setting up the global standards for guided wave pipeline inspection and monitoring, and has been committed to continuous improvement to meet the needs and expectations of clients and the wider industry.

Guided Wave Testing

Guided Wave Testing (GWT) is a Non Destructive Testing (NDT) method, that is largely used to avoid expensive invasive investigations. The method exploits mechanical stress waves that are guided by the walls of the pipe, so it can rapidly provide 100% coverage.

GUL Guided Wave Monitoring Sensors – gPIMS®

Screening

Today a conventional role for guided wave testing is screening. The echoes returning from discontinuities and received by the instrumentation indicate the severity of any findings, but they do not give detailed information about the morphology or dimensions of the damage. Therefore, most inspection procedures deploy guided waves to indicate locations of concern, and then follow up with localized inspection techniques where required.

This is a practical combination: GWT provides a high probability of detection, and the local follow up inspection provides a high probability of correctly assessing the impact the defect will have on the integrity of the pipe.

Typically, guided wave test instruments are battery powered, portable, and fully ruggedized for deployment in the field. The instrument is connected to the transducer ring, which is mounted on the pipe, by two flexible cables. The test is controlled by bespoke software – WavePro™ – on a ruggedized and portable computer that is connected to the instrument by a USB cable. The setup of the GWT equipment and collection of the data can be achieved within minutes.

The innovative Wavemaker® system is the most reliable long range screening equipment in the market. The G4mini is the latest instrument model, a device with extended capacity and increased efficiency. The lightweight low profile Compact® rings, with the practical multiple spacing EC Trio modules, are ideal to further increase precision and productivity.

Monitoring

gPIMS® – Guided Wave Permanently Installed Monitoring Sensors (see pic) – was the first and remains the leading edge technology in guided wave monitoring, giving the industry a cost efficient option to continuously evaluate their pipelines. The latest generation of this permanently installed system incorporates multi point wall thickness measurement capability for the pipe circumference area beneath the sensor.

Scanning

The recently released QSR1® is the first quantitative short range guided wave scanning system. Designed to automatically measure wall loss, this instrument allows users to quantify Corrosion Under Pipe Supports (CUPS) before making integrity decisions.

Training

All users are certified following GUL's globally respected training and qualification scheme. This scheme is administered to ensure GUL qualified inspectors are able to provide high quality accurate results.

Consultancy

GUL services also include consultancy and onsite support by some of the world's leading GWT experts, helping our clients to make GWT an efficient solution for their inspection projects.

As guided wave applications expand with new techniques of the method, GUL's position as the global leader for this technology will expand and become ever more important. The company's commitment to continuous innovation and improvement underpins this process.

Why you should attend the South Africa GUL Summit 2018

The **GUL Summit** is the ideal occasion for you to meet our experts in Guided Wave Testing (**GWT**) and see the equipment that will help solve some of your challenges.

November 20 – Johannesburg
SAIW Headquarters

November 22 – Trichardt
Multilink Conference Centre

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