Fusion

Newsletter of the Southern African Institute of Welding

August 2017

SAIW
Southern African Institute of Welding

Historic Win for Samukelo Mbambani in China ...

... Team SA sponsored by merSETA

Osbourne Samukelo Mbambani has won first prize in the Student category at the 5th International Arc Cup Welding Competition in Shanghai, China during the week of 24 – 28 June 2017. In total 16 countries participated in the event with Russia alone entering 26 competitors in all categories!

"This is an absolutely amazing result," says Etienne Nell, SAIW business development manager, S.A. team leader in China and Senior Category judge.

"Samukelo simply blew everyone away with his attitude, skill and application. Given the facts that: he had never even been on an overseas trip before; that he competed against dozens of the best young welders in the world in a strange country; and that the marking was amongst the strictest of any world competition, what he achieved was nothing short of miraculous," Nell says.

SAIW competitor, Samukelo Mbambani, sponsored by MERSETA, has won first prize in the Student category at the 5th International Arc Cup

merSETA
MANUFACTURING, ENGINEERING AND RELATED SERVICES SETA

He adds that Samukelo's relaxed, humorous and easy-going approach was matched with an incredible discipline and willingness to give of his best. "He was the perfect competitor and was a credit to himself, the SAIW and South Africa."

There were four categories of welding in the competition:

- **Student Welder (max. age 22)** - here the competitor firstly welds a plate, pipe and fillet weld using a specific process – GMAW in the case of Samukelo. Then they enter the Finished Welding category where they assemble and weld, in all positions, a carbon steel project with all four processes i.e. GTAW, GMAW, SMAW and FCAW. Samukelo participated in both categories.
- **Senior Welder (max. age 35)** – process as per the Student Welder above. Houston Isaacs the multi-winning welder in the various local SAIW welding competitions represented South Africa in this category. While Jaco van Deventer achieved second place in this category last year, Houston was unable to attain his usual winning standards this year.
- **Robotic Welding (no entry from S.A.)**
- **Technology/Theory (no entry from S.A.)**

Nell says that the story of Samukelo getting to China is in itself quite bizarre. "He wasn't meant to go at all. SAIW Welding Challenge second-placed Angel Mathebula was originally supposed to participate in the Student Category but had to withdraw for personal reasons.

Continued on page 2

Historic Win for Samukelo Mbambani in China

Continued from page 1

So, we decided to take a chance on Samukelo who was placed third in the WorldSkills S.A. Nationals in Durban earlier this year. The rest is history … in the truest sense of the word," says Nell.

Samukelo was over the moon with his achievement. "China and the Arc Cup was an incredible experience. I never expected to win but it goes to show that one can only do one's best and hope that it's enough. This time it was! I must thank Etienne, the sponsors and the whole team for their support," he said.

The ARC Cup is the Chinese version of the WorldSkills competition and is highly regarded by the welding industry globally including the International Institute of Welding (IIW).

The South Africa Welding Team was sponsored by the Merseta. The team consisted of four people - Etienne Nell, team leader and Senior Category Judge; Valencia Hendriks coach and Junior Judge; and competitors Houston Isaacs and Samukelo Mbambani.

South Africa Now Part of Important International Welding Alliance

South Africa, through the SAIW, is now part of a powerful international welding alliance – The International Alliance for Skills Development Belt and Road including BRICS (IASDBR) – which aims at incorporating all the countries in this region in a cooperative initiative to provide welding training to the youth.

"The training will align with the International Institute of Welding (IIW) standards and will help to boost employment in the welding industry throughout the alliance countries," says Etienne Nell SAIW new business manager.

He adds that throughout the world welding is an excellent career choice for young people even in more challenging economic conditions. "With so many powerful countries pulling together the opportunities for young people to develop a job-providing skill will grow exponentially," he says.

South Africa became a member of the alliance when Nell signed the agreement on behalf of the SAIW at the opening ceremony of the ARC Cup, which was held recently in Shanghai, China.

Some of the countries that will be working closely together are: South Africa, China, Russia, India, Ukraine, Singapore, Philippines, Cameroon, Ghana, Nigeria and others.

Belt and Road Initiative

The Silk Road Economic Belt and the 21st-century Maritime Silk Road, also known as the Belt and Road Initiative (BRI) is a development strategy proposed by Chinese President Xi Jinping that focuses on connectivity and cooperation between Eurasian countries, primarily the People's Republic of China, the land-based "Silk Road Economic Belt" (SREB) and the oceangoing "Maritime Silk Road" (MSR).

BRICS

BRICS is the acronym for an association of five major emerging national economies: Brazil, Russia, India, China and South Africa. Originally the first four were grouped as "BRIC" before the induction of South Africa in 2010. The BRICS members are all leading developing or newly industrialized countries, but they are distinguished by their large, sometimes fast-growing economies and significant influence on regional affairs; all five are G-20 members.

The Belt and Road countries (above) and the BRICS countries form powerful international alliance

SAIW Member of the Arc Cup Organising Committee

Yet another accolade of significance has come the SAIW's way!

At the recently-held Arc Cup in Shanghai, China the Institute was asked to become a member of the Arc Cup organising committee and the SAIW readily agreed!

"Not only is this a wonderful honour for the Institute but it also makes sense as this competition is becoming increasingly central to our international welding activities," says Etienne Nell, SAIW new business manager.

Arc Cup is one of the world's leading welding competitions

Nell is referring to the fact that the SAIW has recently become a signatory to the International Alliance for Skills Development Belt and Road including BRICS (IASDBR), which aims at incorporating all the countries in this region - including several African countries, China, Russia, India, Ukraine and many more - in a cooperative initiative to provide welding training to the youth.

He says that this puts the SAIW on centre stage in terms of welding in the developing world.

"We will be upping the ante in terms of finding South African youth to participate in the Arc Cup. Obviously we will be using our own Youth Challenge competitions as a source and we also hope to host a series of mini competitions throughout the country specifically for the Arc Cup which would have the dual effect of training young people, through international experience, to do well in the SAIW Youth Challenge," Nell concluded.

SAIW in Vienna for International Conferences and Meetings

SAIW executive director, Sean Blake, and systems and quality manager, Harold Jansen, represented the SAIW during two consecutive international conferences held in Vienna, Austria between 29 May and 7 June 2017.

The first-ever International Conference on the IAEA Technical Cooperation Programme: "Sixty years and Beyond – Contributing to Development", was held from 30 May to 1 June. Prior to and following this conference, meetings of National Liaison Officers (NLOs) and Focal Points of AFRA Regional Designated Centres (RDC) were held.

SAIW has been the Anglophone RDC for Africa since the late 1990s and was able to change the lives of 251 individuals from 21 different countries, with the cooperation and sponsorship of the IAEA, through SAIW NDT Level 1 to Level 3 training programmes. Since the successful conclusion of the Regional NDT development project in 2011, obtaining sponsorship for further development in NDT has been challenging and the objective of SAIW personnel was to identify future prospects for liaison between SAIW and IAEA in the field of NDT on the African continent.

The 8th International Conference on Certification and Standardisation in NDT – '5 years of EN ISO 9712 – What's next / how to go on?' was held on 6th and 7th of June 2017, with ICNDT (The World Organisation for NDT) Working Group 1 – Qualification & Certification and IEC (executive committee) meetings scheduled for the 5th and 7th of June, respectively. SAIW was represented on all these meetings with Harold Jansen presenting a paper during the conference titled 'Competence of NDT Personnel'.

"The global standard for Qualification and Certification of NDT personnel, ISO 9712, is due for its systematic review and SAIW, in collaboration with SAINT, was privileged to represent the South African NDT industry at this international forum," says Jansen. "Representatives were able to actively participate within the various forums, prior to and during the conference, with proposed changes to the ISO 9712 standard being suggested from a South African perspective.

Both Sean Blake and Harold Jansen would like to express their gratitude to the SAIW Board for making this very important international interaction possible.

Sean Blake has been the Anglophone RDC for Africa since the late 1990s and, with the cooperation and sponsorship of the IAEA, has been changing lives through SAIW NDT Level 1 to Level 3 training programmes.

New National Welder Qualification Matches IIW Standards


Etienne Nell has driven this process for years

Following four years of CHIETA-funded planning and curriculum development work, the Quality Council for Trades and Occupations (QCTO) has released a new national welder qualification for welders that is now ready for implementation and which matches IIW standards.

Sparking skills: QCTO artisan welder training

Talking at an education solutions seminar hosted by Lincoln Electric on May 9 and 10, 2017, SAIW's Etienne Nell presented a talk entitled 'A Sparking Change' about the new choices South Africa has made with respect to welder training and certification.

"How many welders do we need in South Africa?" Nell asks as the question of the day. "Welding has been identified as one of the scarce skills in South Africa and a worldwide shortage, with the AWS indicating a shortage of 250 000 skilled welding personnel by 2020," he says.

Adding to the problem, he says: very few welders are properly qualified and certified; very few meet the required skill level needed for new and existing projects; very few are qualified for the welding processes or for the positions required on these projects; and very few welders or employers understand the term 'coded welder'.

This leads to the need to do something more to develop skilled welding artisans, because: "welding skills secure employment with excellent financial prospects; new projects require highly skilled welders; of the legislation requirement embedded in our National Health and Safety Standards; welding skills are required for compliance with quality standards".

The solution: a quality skills training programme

In introducing the training solution currently being implemented in South Africa, Nell cites three components for a lasting solution to our welding skills problems: Authorised Training Bodies (ATBs); the new Quality Council for Trades and Occupations (QCTO) curricula for artisan training; and reputable training equipment suppliers, such as Lincoln Electric, Afrox, ESAB, and Fronius.

A trainee producing fillet welds on plate in the 4F (overhead) position.

Facilities accredited by SAIW Certification, which is the International Institute of Welding's (IIW) Authorised National Body (ANB) in South Africa, are at the starting point of any long-term solution to the welding skills problem. "ANBs seek to achieve excellence in the training, examination and qualification of welders throughout the world," Nell says.

IIW-accredited training bodies (ATBs) in every member country now follow a detailed welder-training guide called the 'Bratislava Agreement', which was developed and agreed by all 56 IIW member countries.

"WE AT THE SAIW HAVE BEEN IIW-FOCUSED FOR OVER 16 YEARS NOW AND WE HAVE ALREADY APPLIED FOR QCTO ACCREDITATION FOR OUR TRAINING SCHOOL. OUR 2017 INTAKE OF FOUNDATION STUDENTS WILL BE THE FIRST GROUP TO BE TAKEN THROUGH THE NEW QCTO-CURRICULUM." – Etienne Nell

Articulated in full in the IIW Guideline document entitled: *'International Welder, Minimum Requirements for the Education, Examination and Qualification'*, the Bratislava Agreement seeks to achieve *'harmonisation in the training, examination and qualification testing of welders in the world. It provides for the assessment of both theoretical knowledge and practical skills, the latter being linked to the requirements of ISO 9606 (or equivalent standard) …'*

"The new South African QCTO curriculum, is 90% based on the Bratislava Agreement," says Nell, which makes it a truly international curriculum.

This was looked at over a period of over two years by a welder training curriculum development committee consisting of senior academic and industry stakeholders, including: Etienne Nell from SAIW, Tony Paterson from Wits University, Louis Petrick from Eskom, and people from Bell, Coega, PetroSA; Caltex; Sapref, and several other stalwarts of the South African welding industry.

This QCTO curriculum is now a national qualification called Occupational Certificate: Welder, with the SAQA Number: 94100 and QCTO Curriculum Number: 651202. While it does not replace any other qualification and it is not replaced by any other qualification, anyone wanting to register a new apprentice for a trade must, from now on, “go the QCTO route” with respect to training.

Apprentices already on existing schemes may finish these programmes, but the new welding artisan trade tests will be QCTO-based within the next three to four years.

“If one looks at the total number of hours a university student spends before being granted a degree, it equates to about 5 400 hours. Of that time, the direct number of contact hours per week is often low: the holidays are long and study leave is counted.” Nell says.

“The welder training committee thought it best to stop labelling university trained professionals as ‘white collar’ and artisans as ‘blue collar’. So now, to become an artisan, a candidate still has to do 5 400 hours of training so that everyone is on the same level,” Nell says.

A trainee practising his gas-tungsten arc (GTAW) skills in the SAIW welding school.

The QCTO curriculum is structured around credits, with each credit equating to 10 notional hours of time. That means that artisan courses now consist of a total of 540 credits to give the 5 400 hours that makes them equivalent to a university degree.

Breaking down the general QCTO artisan training course curriculum requirements, Nell says that 20% of the 540 credits, 108 credits, is allocated to theory; a second 20%/108 credits to practical Institutional training at a training facility; while a third 20% is allocated to relevant workplace experience. This applies to all occupations.

The remaining 40% is left up to individual training committees to allocate depending on needs of their occupation.

“For welding, we decided to increase the practical institutional training by a further 10%, from 108 credits to 162 credits. The remaining 30% was allocated to workplace experience, which was raised from 108 credits to 270 credits,” notes Nell.

Being based on the Bratislava Agreement’s International Welder curriculum, the QCTO’s Occupational Certificate: Welder is structured around practical cutting and welding activities, including: performing cutting operations using oxy-fuel, carbon arc and plasma processes; producing fillet welds on plate; producing fillet welds on pipe; producing butt or groove welds on plate; and producing butt or groove welds on pipe – with each positional skill having to be developed using SMAW (MMA), GTAW (TIG), GMAW (MIG/MAG) and FCAW processes.

“From now on, all welding training providers will have to comply with this structure – and the instructors delivering the theory component need to be qualified artisans themselves, with experience and the requisite knowledge components,” Nell says.

Also, the training provider will not be allowed to administer the trade tests themselves. TVET colleges have been earmarked for delivering these trade tests. Any provider can train, if accredited, but TVET colleges that provide welder training will not be allowed to also administer the test.

“While the curriculum is written and ready, the welding trade test development is yet to be completed,” Nell says. This is being done via the National Artisans Moderation Board (NAMB), also with Nell’s participation. “We are currently determining the requirements and assessment criteria and, once completed, we will proceed to the approval of testing facilities,” he says.

Summarising the new approach Nell lists the following advantages:

1 This is a listed trade qualification that falls within the Occupational Qualifications Framework of the NQF of South Africa.
2 Industries employ welders qualified as artisans, but they need them to perform the code certification requirements using ‘Coded Welders‘ according to the relevant national standard applicable to the scope of work, (PER or Structural)
3 The implementation strives to eliminate skills imports by providing highly skilled local welders to our labour market.
4 The availability of this qualification, aligned to international standards is regarded as an important resource to support national artisan development.

“This qualification ensures that a sound skills base is developed at artisan level that will serve as the foundation for achieving the coded welder status required by the national standards used in South Africa,” he adds.

“We at the SAIW have been IIW-focused for over 16 years now and we have already applied for QCTO accreditation for our training school. Our 2017 intake of foundation students will be the first group to be taken through the new QCTO-curriculum,” Nell concludes.

SAIW’s state-of-the-art welding school: an accredited IIW ATB for the delivery of the IIW International Welder curriculum.

JOB KNOWLEDGE 124

Radiography

The previous two Connect articles dealt with the defect detection techniques of MPI, LPI and eddy current testing. These methods are capable of detecting surface or very near surface imperfections and some process is therefore required to enable buried imperfections to be reliably detected – a so-called volumetric detection method. The first such method to be used in manufacturing to determine the quality of fabricated components is radiography. X-rays generated from a cathode ray tube were discovered in the late 1890s, soon followed by the discovery of gamma radiation from radioactive isotopes.

The ability of this radiation to penetrate both living and inert objects with the amount of transmitted radiation depending on the density, thickness, and atomic number of the object was eventually understood. The transmitted radiation was found to produce images on photographic film and these findings resulted in the development of industrial radiography as illustrated in Fig 1.

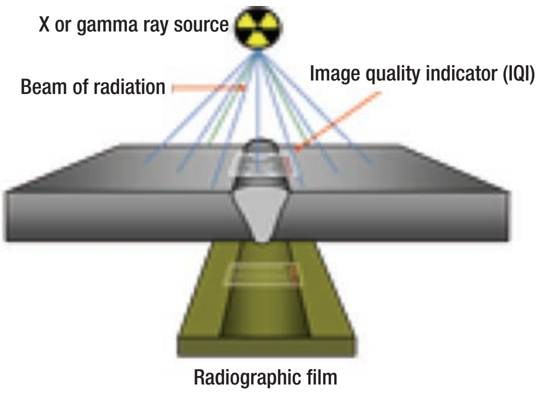


Fig. 1. Principles of radiography

X-radiation is produced from a vacuum tube - this contains a cathode which produces a beam of electrons when an electric current is passed, the higher the voltage the more intense is the stream of electrons and the deeper the penetration – see Table 1. Industrial X-ray tubes use voltages between 20kV and some 450kV but up to 30MV in linear accelerator and betatron equipment.

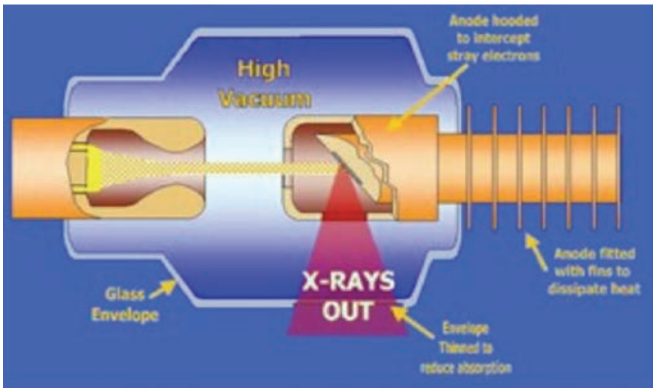


Fig. 2 Schematic of an X-ray tube

The stream of electrons impacts an anode, some 1% of the energy being emitted as a beam of X-rays, the remainder being released as heat, requiring the anode to be cooled, often with water or oil. A schematic of an X-ray tube is shown as Fig. 2. The anode can be designed to provide a beam as illustrated in Fig. 2 or a 3600 panoramic beam, typically used for pipe butt weld inspection with the X-ray source inside the pipe.

kV	Maximum Thickness (mm)	
	Steel	Aluminium
50	1	12
100	20	60
150	30	80
200	50	100
300	80	150
400	100	200
2000(2MV)	200	500
25000(25MV)	500	1400

Table 1 Applied kV and maximum thickness

Gamma radiation is naturally occurring and is produced by the decay of a radioactive isotope which, when it decays, emits three types of radiation, alpha, beta and gamma. Alpha and beta radiation are short range and very easily absorbed – gamma radiation, however, is very energetic, typically over 100keV, and can easily pass through a metal, the thickness that can be penetrated depending on the type and size of isotope. The isotopes are stored in shielded containers from which they can be wound to expose the isotope, as shown in Fig 3.

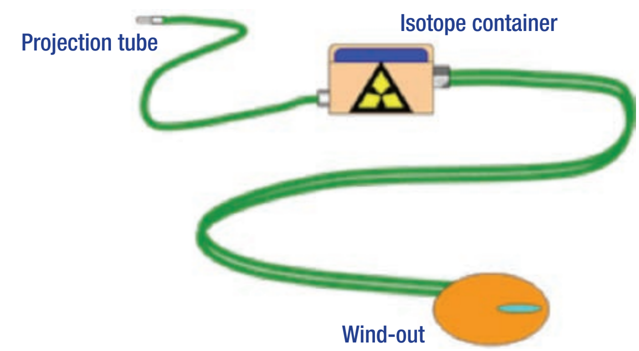


Fig 3. Typical arrangement of gamma ray NDE equipment

Each isotope has a "half-life"- a length of time by which half (50%) of the radioactive isotope has decayed into a stable element – two half-lives means the source has only 25% of its original strength, three half-lives 12.5%. As the source decays and becomes less energetic the length of the exposure time must be increased to achieve the same density of image on the radiographic film. There is thus a point at which use of the gamma ray source is discontinued and replaced with a fresh isotope. In addition, because the gamma radiation emitted by an isotope cannot be varied in quality there is a range of material thickness for which each source will give acceptable results. The commonest isotope in regular use is iridium192 with cobalt 60 being used for very thick components.

Isotope	Half Life	Typical Thickness Range – steel (mm)
Iridium 192	74 days	10 - 50
Cobalt 60	5.26 years	25 - 200
Ytterbium 169	32 days	< 10
Thulium 170	128 days	< 10
Selenium 75	119 days	5 - 20
Caesium 137	30 years	20 - 80

Table 2 Half-life and typical thickness range of industrial isotopes.

The film is a fine grained photographic film with a coating of a light sensitive emulsion on both sides which is loaded in a darkroom into a flexible cassette. The cassette contains an intensifying screen, a card mounted thin lead foil, 0.05 mm to 0.5mm thick, held in close contact with the film. This screen absorbs stray radiation and emits electrons that enable the exposure time to be substantially reduced without affecting the radiographic quality.

SHARPNESS OF THE IMAGE IS A FUNCTION OF A NUMBER OF FACTORS, A RADIOGRAPH WITH POOR SHARPNESS BEING SOMEWHAT SIMILAR TO AN OUT-OF-FOCUS PHOTOGRAPH WITH FINE DETAILS BEING BLURRED OR NOT VISIBLE.

The quality of a radiograph is assessed using three factors – density, contrast and definition or sharpness of the image. Most specifications require film densities in the range 1.8 to 2.5 (film density = 1, 1/10th of light is transmitted: film density = 2, 1/100th of light is transmitted). The density of the film can be measured using a densitometer; films outside of the specified range of density would be rejected. The density is affected by the exposure time and metal thickness – this can make the radiography of components with dissimilar thicknesses problematic – thin sections being over-exposed, thick sections under-exposed.

The contrast is determined by the differences in absorption between the metal and the defect and by the type of film used. The speed of the film in particular affects the contrast of the image. Most weld defects are less absorbing than the surrounding metal – slag, porosity, lack of fusion or penetration etc therefore appear dark against a lighter background. The only weld defects that are more absorbing than the parent metal are tungsten inclusions that appear as bright white specks on the film.

Sharpness of the image is a function of a number of factors, a radiograph with poor sharpness being somewhat similar to an out-of-focus photograph with fine details being blurred or not visible. Film with a very fine grain size is preferred for high quality radiography, being capable of resolving fine details. There is a geometric unsharpness caused by the size of the radiation source, known as the “focal spot”.

A large diameter source will cause a penumbra which means that the edges of an image become blurred as shown in Fig. 4. The further away from the item being radiographed than the less obvious is this effect – unfortunately the further away the source is from the object then the longer is the exposure time – twice the distance quadruples the time. To minimise the penumbra and increase sharpness the source should be the smallest diameter possible; the film should be as close to the back of the object as possible; the source should be as far from the object as possible, bearing in mind the lengthening of exposure time; fine grained film should be used.

Additional unsharpness is caused by the release of electrons within the film emulsion that darken the adjacent area.

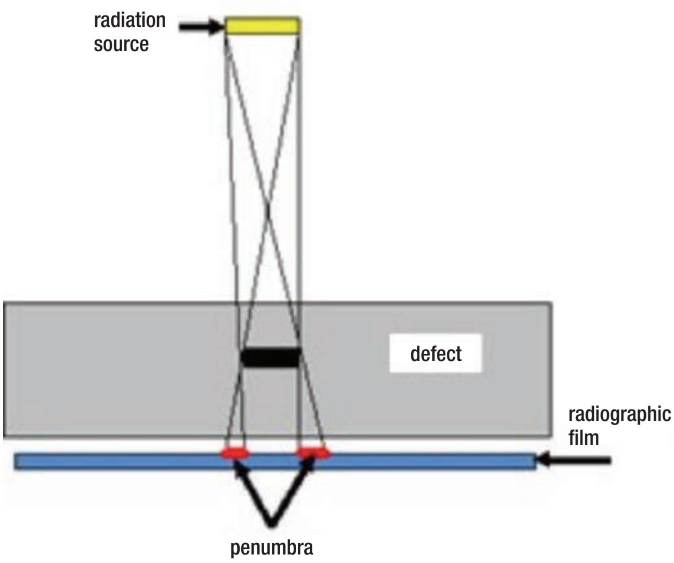


Fig 4. Formation of a penumbra

To ensure that radiographs are of an acceptable quality with respect to image sharpness, contrast etc it is a requirement that an image quality indicator (IQI) is used as can be seen in Fig. 1.

This topic will be covered in the next Fusion, as will the techniques for radiography of a variety of joint types and component configurations.

Focus on Courses

NDT – Visual Testing

Harold Jansen

Introduction

"I see no more than you, but I have trained myself to notice what I see".

These words from the renowned fictional detective Sherlock Holmes, capture the essence of one of the most popular Non-Destructive Testing (NDT) methods utilised today, called Visual Testing.

Visual testing, as the term implies, is the visual observation of material or components, big or small, throughout its 'engineering lifespan' which stretches from initial manufacture, through the formation / shaping processes, during assembly and construction, until commissioning, operation, in-service testing and maintenance up to the final decommissioning phase.

Visual testing is an essential tool to assess any engineering product, within a specific sector, throughout it's engineering 'life' to ensure optimum performance by eliminating or addressing 'obvious visual' problems.

Visual testing - definition

Visual testing can be described as the interaction of the visible portion of the electromagnetic spectrum with a test surface (or volume, in the case of translucent materials) and the consequent observation of changes in the light beam, which in this case is the inspection medium, caused by the presence of a discontinuity.

Visual testing techniques

There are three basic visual testing techniques, viz. direct, indirect and translucent techniques.

Direct visual testing refers to direct observation of an accessible inspection surface, with the eye placed within 600mm of the area of interest. The incident angle between the eye and the inspection surface should not exceed 60 degrees, or else the inspection can be regarded as a profile assessment rather than a surface inspection method.

Mirrors may be used to modify this angle of vision or even to illuminate the inspection surface. Magnifying lenses (usually not exceeding 10 x magnification) may be used to assist the testing process.

Indirect or remote visual testing relies on the use of equipment such as borescopes, fiberscopes, video probes or cameras, manipulated via mechanical means, such as remotely operated robots or drones, to make a hard to reach surface visually observable. In both cases, the image resolution, also referred to as image detail, must be comparable and aspects such as digital pixel size and colour image sensors come into play.

Translucent visual testing can only be performed if light can be transmitted through the material under test. This technique is very seldom used in general engineering since most engineering materials are opaque.


Harold Jansen

The difference between visual testing and visual inspection

It is clear from the techniques mentioned above, that visual testing usually relates to the identification of discontinuities relating to either welded (as per ISO 5718), casted (EN1559 Parts 1 to 6) or wrought (EN 10163 Parts 1-3) products.

Visual inspection on the other hand can be considered as the overall component inspection and includes aspects such as geometric verification, compliance with fabrication specification and overall structural integrity.

Engineering components, therefore, have to undergo both visual inspection (looking at the component as a whole) and visual testing (having a closer look for discontinuities that might influence the operability of a component).

Competence of Visual Testing personnel.

The competence of visual testing personnel is obviously critical, whether inspecting according to ASME, ISO or EN manufacturing codes. ISO 9712, the internationally recognised standard for qualification and certification of NDT personnel, can be used as the foundation to implement, manage and develop personnel competence within the field of visual testing, whether it is competence verification by the manufacturer, company certification (authorisation) or third party conformity assessment schemes that is required.

In general, responsibilities are assigned in accordance with the qualification levels, as stipulated within ISO 9712, with Level 1 personnel performing the visual tests, Level 2 personnel guiding, supervising and reporting on the tests results and the Level 3 personnel creating and maintaining the quality environment within which these tests are conducted. Needless to say, Level 2 and 3 personnel should also be able to operate at level 1, and similarly level 3s should also be able to perform the duties of Level 2 personnel.

Basic course content

The course content can be divided into similar sections, whether it's level 1, 2 or 3. The aspects, extent and complexity will however differ.

The training course kicks off with a basic introduction during which time the history, objective and basic terminology is covered. This is followed by the physical / theoretical fundamentals relating to vision, light, optics, material attributes, etc. Since the basic equipment used during visual testing is the human eye, it is pretty certain that a thorough understanding of its workings, related limitations and problems, will form an intricate part of the visual testing course, regardless of the level.

Visual testing is essential for engineering processes

Product knowledge relating to welds, castings and forgings in accordance with the relevant ISO (or EN, if no relevant ISO code exists) or ASME (also ASTM/API, where applicable) codes are addressed. Additional equipment, designs, applications and limitations are also discussed.

Operations prior to, during and following inspections, such as reporting, are covered and students are, throughout the course, expected to complete assignments and tasks so their learning progress can be assessed and to allow them to master the required skills for inspecting and reporting on the various product sectors covered by the pre and in-service industry sector.

Related quality documentation such as written instructions and procedures are included, with level 2 and Level 3s respectively expected to compile their own documents relating to samples provided.

Qualification and certification

Following the successful completion of the training course, students are expected to pass the independent qualification examination, as described in ISO 9712. Only after the relevant industrial experience under qualified supervision and based on a structured industrial experience matrix has been concluded, will the student be eligible for certification.

NDT certification needs to be renewed / recertified every five years as per the requirements of the personnel certification body.

Conclusion

Visual testing is essential for engineering processes and the value added by the testing report is directly related to the competence, dedication and attitude of the inspection personnel.

'Competence' can be defined as the continued development (learning, mentoring and demonstration); evaluation (examination, assessment and approval); mastering of skills through defined experience and outcomes, ability to perform Non-Destructive Testing tasks as per the competencies defined within the various qualification levels. Furthermore, competency should be confirmed at realistic intervals via personnel certification, company authorisation and even customer approval, through a systematic process.

Remember, dedication and attitude is accomplished through hard work and perseverance!

Please contact the SAIW or visit our website at www.saiw.co.za should you have any further queries.

Demand Grows for 3834 Certification

The demand keeps on growing for ISO 3834 certification. This is according to Herman Potgieter CEO SAIW Certification which manages the ISO 3834 certification process. "Sometimes people support something only because they see so many other people doing it. But this is not the case in our industry because we think about things carefully before we do anything," he says.

"In simple terms the demand is growing because ISO 3834 certification is so very important," says Potgieter. "It's the basic stamp of quality in the welding fabrication business and it is a considerable boost to one's business potential."

He adds that ISO 3834 certification is for all fabricators. "I must reiterate that this is not for big companies only. It's for all companies. In fact smaller, lesser known companies could benefit more because this stamp of approval shows they're on a par with the best."

Companies Certified during 2017 include: LHL Engineering; Lead EPC; Murray and Roberts – Secunda Oil and Gas; FFS Refiners; HC Heat Exchangers; Medi-Clave; Master and Master Engineering; Vessel Fab; Steval Engineering; Clarko Piping Contractors; AWS Pipelines; Mbali Industrial Solutions

All these companies now have IIW Manufacturer Certification Scheme certificates that testify compliance with ISO 3834: Quality requirements for fusion welding of metallic materials.

FFS Refiners – Pressure Piping, Pressure Vessels, Tanks and General Structural Steel

Cape Town Celebrates

At a ceremony earlier this year SAIW Cape Town branch rewarded its successful graduates with certificates and an evening of entertainment and fun. It is pleasing to see that this branch continues to produce such outstanding results.

SENIOR INSPECTOR LEVEL 2 & IIW (S)

Gershwin McMillan with SAIW Certification MD, Herman Potgieter

IIW - SPECIALIST

Thabo Khongoana with SAIW Certification MD, Herman Potgieter

WELDING INSPECTOR LEVEL 1

WELDING INSPECTOR LEVEL 2

In the SPOTLIGHT

MARIUS PURCELL

IN OUR SERIES OF PROFILES ON PEOPLE WHO HAVE MADE A DIFFERENCE TO THE WELDING/ NDT INDUSTRY AND THE SAIW, WE TALK TO MARIUS PURCELL, NON-DESTUCTIVE TESTING (NDT) MANAGER AT SASOL - WHEN HE'S NOT "BEING A JEDI KNIGHT!" BORN IN 1990 IN TSHWANE HE WENT TO SCHOOL IN EVANDER, MPUMULANGA WHERE HE MATRICULATED IN 2009. MARIUS'S POST-SCHOOL EDUCATION WAS MAINLY THROUGH THE SAIW - WHILE WORKING AT SASOL - WHERE HE COMPLETED THE FOLLOWING: WELDING AND FABRICATION INSPECTOR LEVEL 1 AND 2; COMPETENT PERSON PRESSURE VESSELS AND STEAM GENERATORS; UT LEVEL 1, 2 AND 3; MT LEVEL 1, 2 AND 3; PT LEVEL 1, 2 & 3; AND RT LEVEL 3 AND RADIOGRAPHIC FILM INTERPRETATION.

F: Tell us a bit about you career, how and where it began

MP: In 2010, the year after my matric, I was fortunate enough to be given the opportunity by Sasol to learn Industrial Inspection by means of a three-year learner Inspector training program. It wasn't until 2012 that I realised I wanted to specialize in the theoretical and practical practice of physics in the form of NDT. I became a certified SAQCC CP-PV in 2013 and a certified SAQCC NDT Level III in 2016. Today I'm involved in both these fields of practice.

F: You've been a Sasol employee since 2010 and seemed to have climbed the ladder relatively quickly?

MP: Well yes. I' like to think it's been quick - for a Jedi Knight that is! Currently I am managing all NDT related activities within the Sasol Group, which includes research and development, failure analysis and investigations, complex inspection technique evaluations and consultation on an International scale for all Sasol groups.

F: Any achievements that stand out for you?

MP: Amongst my achievements that I'm most proud of in this role comes from two case studies: - "Internal development of the Acceptance of HDPE Composite Material Evaluations Using Time-of-Flight-Diffraction" and "Online Inspection Technique Development and Implementations at Elevated Temperatures of up to 400°C". I must add that neither of the above would be a reality if it wasn't for the constant drive and motivation from, especially, John Mitchell and Paul Bruwer.

F: How did you get involved with the SAIW?

MP: Of course my first involvement with the SAIW was due to my early courses and then later specializing in NDT. It was the late Mark Mason who chaired the SAQCC NDT Committee that brought me in closer relation to the SAIW and introduced me to higher NDT education.

F: What do you think of the standard of Welding/NDT in South Africa and comment on the role that the SAIW is playing?

MP: Welding in South Africa is of a very high standard and is on par with international, industrial achievements. The SAIW has played an important role in this. Today it is the leading welder training organisation in Africa and provides important opportunities for the youth to get real jobs in a challenging economy.

From an NDT perspective, despite the fact that there are world class individuals within the field in this country, we tend to neglect the technological growth of NDT. However, standardization for quality assurance in qualification and certification, the exception to the latter, is where the SAIW plays a vital role in providing highly trained individuals delivering certification of the highest international standards.

F: What do you feel about the prospects for the inspection industry in general in South Africa in the long term?

MP: Inspection in South Africa is a field with a lot of potential for growth. With the Pressure Equipment Regulations now providing national conformity for all assets helps the inspection field to be more quality driven. With the latter conformity and regulatory inspection in place, Inspection in South Africa is a valuable asset which will enjoy a productive and harmonious future.

F: Tell us something about your personal life:

MP: I'm married to the most beautiful, courageous and strong-willed woman in what we perceive as our universe, Thea Purcell. I have a little boy Dylan Wagner, who is going to be a Jedi Knight and a tiny Padawan who is expected in September. I'm a straight-up nerd that games, reads comics and collects action figures. I spend a considerable amount of my time on science and philosophy and I'm hoping to become a writer of Afrikaans literature and philosophy one day.

F: How does NDT fit into all of this?

MP: I'm weird. That's how ☺

FOCUS ON STANDARDS

TECHNICAL REPORT ISO/TR 17844

Welding — Comparison of standardised methods for the avoidance of cold cracks

The purpose of this document is to compare currently available methods for determining welding procedures for avoiding hydrogen induced cold cracking during fabrication. This subject has been extensively studied in recent years and many methods of providing guidance on avoidance of cold cracking have been published.

These methods vary considerably in how comprehensively the subject has to be treated. It was considered appropriate to set certain important working criteria for selecting the published methods to be included in this document. In deciding which criteria would be adopted it was agreed that these should include the capabilities for effective use by industry, the end user.

Thus the methods should be able to be used on the basis of traditionally available information and relevant factors. The agreed list of criteria was set to include the following main input parameters:

- steel composition;
- welding heat input;
- joint geometry and material thickness;
- weld hydrogen level;
- preheat

and in addition graphical/computer format of data.

Using the above criteria, the following methods were selected:

- *CE* (EN 1011-2/ISO/TR 17671-2, C.2-Method A);
- *CET* (EN 1011-2/ISO/TR 17671-2, C.3-Method B);
- CE_N (JIS B 8285);
- P_{cm} (ANSI/AWS D1.1).

Each method is considered in a separate clause, under the following headings:

- Description of type of test data used to devise the guidelines, e.g. Controlled Thermal Severity (CTS), Y-groove, etc;
- Parent metal composition and range of applicability;
- Material thickness and range of applicability;
- Hydrogen level and welding processes;
- Heat input;
- Other factors/special considerations;
- Determination of preheat (step-by-step example description).

It is important that any calculations using a given method are undertaken using the current edition of the appropriate standard.

Comparison of the different methods

In comparing the methods it is first of all important to recall their origins:

- The *CE*-method uses a critical hardness approach based on data predominantly from CTS fillet weld testing using mainly carbon manganese steels but including some low alloy steels.
- The *CET*-method is an empirical approach based mainly on y-groove testing but incorporates some CTS fillet weld data. Steels tested cover both carbon manganese and low alloy types.
- The CE_N-method is an empirical approach based predominantly on y-groove test data, many of which come from low alloy steels.
- The P_{cm}-method includes both a critical hardness approach, and a hydrogen control method. The hardness control method is principally for carbon manganese and some low alloy steels, but excludes quenched and tempered steels. The hydrogen control approach is said to be for high hardenability, high strength, low alloy steels where hardness control is not practicable.

Parent metal composition range

Element	*CE*	*CET*	CE_N	P_{cm}
	0,30 ≤ *CE* ≤0,70	0,20 ≤ *CET* ≤ 0,50	0,20 ≤ CE_n ≤ 0,60	–
C	≥ 0,05 ≥ 0,25	≥ 0,05 ≥ 0,32	≥ 0,02 ≥ 0,30	NS
Si	≤ 0,8	≤ 0,8	≤ 0,6	NS
Mn	≤ 1,7	≥ 0,5 ≤ 1,9	≤ 2,0	NS
Cr	≤ 0,9	≤ 1,5	≤ 2,5	NS
Cu	≤ 1,0	≤ 0,7	≤ 1,0	NS
Ni	≤ 2,5	≤ 2,5	≤ 3,75	NS
Mo	≤ 0,75	≤ 0,75	≤ 0,75	NS
V	≤ 0,20	≤ 0,18	≤ 0,10	NS
Nb	NS	≤ 0,06	≤ 0,10	NS
B	NA	≤ 0,005	≤ 0,0003	NS
NS – Not specified		NA – Not applicable		

Table 1 — Parent metal composition range

As can be seen in Table 1, there are some differences in the precise compositional ranges covered, that for the CE_N method probably providing the widest coverage.

Joint Geometry

The *CE* and the P_{cm}-methods have detailed approaches to providing guidance for fillet welds as well as for butt welds. In certain cases the *CE*-method results in higher preheat temperatures for fillet welds than for butt welds due to the influence of the combined plate thickness. The P_{cm}-method allows determination of the preheat temperature for fillet welds of certain steels depending on the hardening in the HAZ. For all the other steels the P_{cm}-method does not distinguish between preheating of fillet and butt welds, of the same weld thickness.

Both the CE_N - and *CET*-methods make no fundamental distinction between butt and fillet welds, predicting preheats for butt welds, although some limited guidance on fillet welds is provided by the *CET*-method.

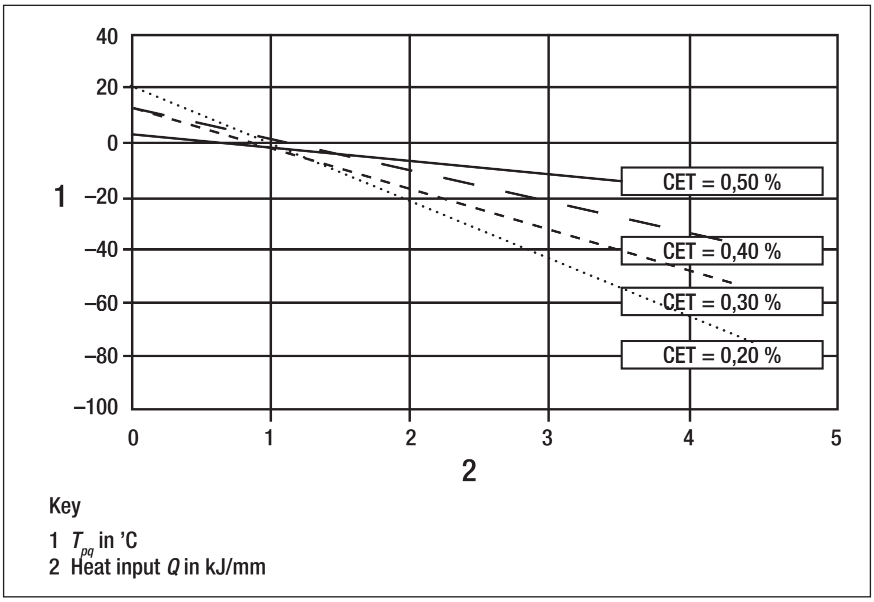


Figure 1 — Preheat temperature in relation to heat input, Q

Plate Thickness

The plate thickness ranges covered are similar for *CE*, *CET* and P_{cm} with an upper limit of 100 mm, while the upper limit for CE_N is 200 mm.

Hydrogen levels

For the CE_N and *CET* approaches, hydrogen input is via any value, between 1 ml/100 g and 20ml/100 g for *CET* and a limit is not defined in CE_N. For the *CE* and P_{cm} approaches, hydrogen input is via a scale or group covering a range of hydrogen levels.

Heat input

For the *CE*- and the CE_N-method the heat input for no preheating can be determined for butt welds while for fillet welds the parameters can be determined only by the *CE*- and P_{cm}-methods. Most of the P_{cm}-method does not take account of heat input. Thus, full advantage of the benefit of increased heat input in reducing HAZ hardness cannot be used with the P_{cm}-method, except for the case of fillet welds and no preheat. For butt welds this point is well illustrated when considering for the same plate thickness and heat input for construction steel S355NH, calculating for 25 mm and 3 kJ/mm, the P_{cm}-method nearly always products the highest preheat when compared to the *CE*-method - 0°C for CE and 116°C for P_{cm}.

Depending on the carbon equivalent **Figure 1** illustrates the influence of the heat input on the preheat temperature for the *CET*-method. This is similar to the *CEN*-method where the heat input up to 4 kJ/mm also influences the preheat temperatures in a certain range depending on the carbon equivalent.

Summary and conclusions

It is clear that there are several distinguishing features to the different methods and these may carry both advantages and disadvantages for the end user, depending on the manner of application. The origins of the different methods should therefore be considered when seeking a method to use with the aim of achieving the best alignment of the practical situation and the original test data when making the selection in the anticipation that this will produce the best prediction. It is recommended that, whichever method is chosen as providing the best fit to the practical situation, it is used for determining preliminary welding conditions to be subsequently validated by appropriate procedure testing and qualifications.

THE ORIGINS OF THE DIFFERENT METHODS, SHOULD THEREFORE BE CONSIDERED WHEN SEEKING A METHOD TO USE, WITH THE AIM OF ACHIEVING THE BEST ALIGNMENT OF THE PRACTICAL SITUATION AND THE ORIGINAL TEST DATA WHEN MAKING THE SELECTION IN THE ANTICIPATION THAT THIS WILL PRODUCE THE BEST PREDICTION.

The user should employ the method that best fits his application. The methods should not prevent an experienced fabricator from using lower preheat temperatures than calculated on the basis of one of the four methods subject to satisfactory practical experience.

Cold cracks – methods for avoidance

Lincoln Emphasises Skills Development …

… and Introduces Cost-saving Welding Technique at SAIW Evening

Lincoln Electric, supplier of welding equipment and solutions, prides itself on promoting welding skills in South Africa. This is according to Thulani Mngomezulu, technical manager at Lincoln Electric South Africa. "Skills development is paramount in our country and is an absolute priority for our company," he says.

It is for this reason that Lincoln is a major sponsor of welding equipment and consumables for WorldSkills International. "Lincoln do not just sell product," says Etienne Nell, SAIW new business manager. "They are very involved in the development of skills in South Africa and globally for that matter."

Recently Lincoln invited all TVET Colleges and other Welder Training providers to an open day where they demonstrated their welding simulators Real-Weld welding monitoring equipment and also set up a live link to their offices in Cleveland, Ohio for an explanation on their numerous online theoretical training programmes.

"It was a most interesting presentation from a company which goes the extra mile in helping customers to maximise their product knowledge and business efficiencies," Nell says.

Thulani Mngomezulu

Lincoln at SAIW Evening – Long Stick Out for Optimising SAW Deposition Rates

Lincoln also goes the extra mile in imparting high-level welding information for the benefit of the industry. Earlier this year Mngomezulu presented a talk about submerged arc welding (SAW) highlighting an effective and cost-efficient way to achieve higher deposition rates.

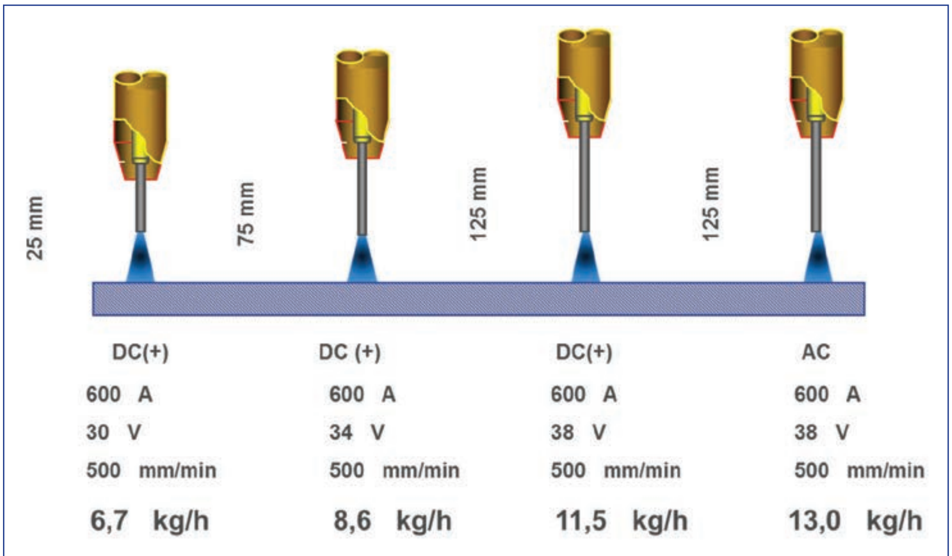
Describing the SAW process, Mngomezulu says it involves solid or cored wired electrodes that are externally shielded via a granular flux. "DCEP (dc+), DCEN (dc-) or ac polarity can be used, with each option being associated with different deposition rates and penetration characteristics," he says.

SAW relies on an electric arc or arcs between one or more wires and the weld pool. The arc and molten metal are shielded by a blanket of granular flux, deposited by welding onto the workpiece. "The process is used without gas and with filler metal from the consumable electrode – and sometimes from a supplemental source," Mngomezulu says.

The advantages over other welding processes include: high deposition rates; typically deep penetration; high operating factors, due to mechanised nature of the process; and low hydrogen levels in deposited weld metal.

Lincoln's range of advanced SAW process options includes: single arc; tiny twin arc – a process that feeds two wires from the single power source to increase deposition rates; and multiple arc actions like tandem; tandem twin; and triple arc systems, which all require more than one welding power source.

Mngomezulu then introduced a way of significantly increasing SAW deposition rates with a single arc, one wire and one power source via Lincoln's Long Stick Out process, which, according to him, takes full advantage of the resistance heating in the process in order to drive deposition rates up.



By extending the stick-out length during welding, Lincoln's Long Stick Out Process preheats the electrode above the arc.

By extending the electrical stick-out length during welding the Long Stick Out process preheats the electrode above the welding arc. This significantly increases the 12R heating and, therefore, the total melt-off rate. Deposition rates using Long Stick Out can be increased by up to 100% without having to increase the current settings," he says.

Critical to the success of this process is the arc striking sequence. "The arc characteristics, as well as the specific arc strike sequence used on Lincoln Power Wave AC/DC 1000 machines overcome this challenge and gives reliable results," he concluded.

Qualification and Certification

CONGRATULATIONS TO THE PEOPLE BELOW WHO RECENTLY ACHIEVED QUALIFICATION AND CERTIFICATION.

COMPETENT PERSON-PRESSURE VESSEL

Fourie JC
Snyman PJ

Competent Person Boilers

None

Inspector of Pressure Equipment

Hendriks DA
Lloyd AK
Smit J
Tissong R

MT 1

Bilala-Banzozi I M
Gudyanga E
Letoaba S
Mahlalela ZT
Mashilwane ET
Metsana MC
Modise MP
Motsaalore KP
Mpumelelo M
Msimang SNS
Siqubudul PT

MT 2

Baloyi NC
De Bruin FM
De Villiers R
Haarhoff JC
Hendricks MA
Jordaan KA
Kushamba J
Matjila MC
Mc Ewan RC
Mthembu SS
Potgieter AE
Skosana MC
Vaughan TL

PT 1

Beselaar Q
Govendar N
Letoba SR
Mabas IP
Mabaso DN
Manentsa P
Mashilwane ET
Matlala KA
Metsana MC
Ndlovu T
Ndlovu T
Seakamela HP
Vermeulen DJ

PT 2

Hendricks MA
Mc Ewan RC
Rafapa JL
Sebetha SS
Waai HK

UT 1

Campbell IR
Chuma MD
Phetla BEZ
Siluma DM

UT 2

Appolis D
Lumby TS
Matjila MC
Mdlalose TF
Reed M
Selepe MS

UT WALL THICKNESS

Chinwuba OR
Hendricks MA
Makua TMF
Mashinini BT
Mc Ewan RC
Miya NE
Mohlahlo R
Mokoena PP
Mosedame JK
Nedambale L
Ngobeni AB
Phoku PN
Ratau PM
Shabangu CB
Sibisi SL
Vaughan TL
Wessels WE
Wynberg DR
Zulu FF

PAINTING INSPECTORS

Cochrane M
Van As E

ASME

Naidoo A

BASICS

Khoza NT
Korf JA
Mndebele NW
Mtetwa D
Mynhardt DM
Namane TD
Stroebel M
Van Rooyen OJ
Zulu SG

RT 1

Badat H
Hendricks DA
Mokoena T
Mushwana E

RT 2

Hefer H
Ismail M
Skosana MC

SAIW NOTICE BOARD

Jim Guild receiving awards in recognition of the successful completion of his term of office as IAB Chair on the IIW Board of Directors 2014 -2017

Jim Guild Honoured

The position of IAB Chair and the associated IIW BoD Directors' position, which Jim Guild recently vacated, is the final achievement in his long and outstanding career with the IIW.

Jim strengthened the position and participation of South Africa in IIW since his first participation in 2001. Then he became actively involved as Chair of IAB Group B from 2004 to 2011 and also participated in C-XIV and SC-QUAL.

Apart from all of this, Jim was the organiser of two IIW congresses in 2006 and 2012 and contributed actively to the development of IIW membership in Africa, especially with Nigeria.

As BoD member Jim has always been committed to active participation and took the leadership in many difficult projects, including compliance and the introduction of the International Welding Inspectors Scheme.

"Jim's contribution to the IIW equals that of his contribution to the SAIW – enormous!" says SAIW executive director," Sean Blake. "This marks the end of an era as far as SA participation in the IIW is concerned. I hope our future eras will be as positive."

Anyone Good Enough for a Major?

Afrox won the SAIW Joburg golf day (l-r) Sean (SAIW) Angelo, Jaco, George

NDE won the Cape Town golf day (l-r) Hein, Liz (SAIW), Michel, Sebastian

JOHANNESBURG (HEAD OFFICE)
Membership Services Secretary: Rencia Grundlingh
Southern African Institute of Welding
52 Western Boulevard off Main Reef Road
City West, Johannesburg
P O Box 527, Crown Mines, 2025
Tel: +27 (0)11 298 2100
Fax: +27 (0)11 836 4132
E-mail: rencia.grundlingh@saiw.co.za

CAPE TOWN
Western Cape Representative: Liz Berry
Unit 38 Milpark Centre, Ixia Street
Milnerton
PO Box 179, Table View, 7439
Tel: +27 (0)21 555 2535
Fax: +27 (0)21 555 2517
Mobile: +27 (0)84 446 0629
E-mail: liz.berry@saiw.co.za

DURBAN
40 Essex Terrace
Westville, Durban
Tel: +27 (0)87 351 6568
E-mail: elizabeth.shole@saiw.co.za