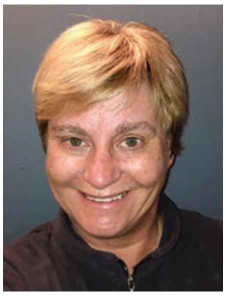
Fusion

Newsletter of the Southern African Institute of Welding

April/May 2019

SAIW Southern African Institute of Welding



Major Improvement to SAIW Flagship Programme …

… Welding Inspectors curriculum to again fully include the iconic SAIW Levels 1 and 2

In the last few years, following a decision to focus more on the internationally recognised International Institute of Welding's (IIW) IWIP Basic, Standard and Comprehensive programmes, the SAIW removed the SAIW Inspectors Level 1 course from its curriculum while SAIW Inspectors Level 2 took somewhat of a back seat.

"In retrospect, we see that this has not worked out in the way it was planned and we will, with immediate effect, be bringing back a new version of the Inspectors programme which includes both the SAIW Inspectors courses and the IIW courses," says Jim Guild, SAIW's caretaker executive director.

He adds that for more than 40 years the SAIW Welding Inspector programme (Level 1 and Level 2) were the backbone of the South African welding industry and by far the most popular courses at the SAIW. Theses courses have been specifically tailored to meet local industry requirements and , since inception, they have been the preferred education and training choice of the large end-user organisations and fabricators in the local welding industry. "It's time to refocus on these iconic courses," says Guild.

SAIW systems and quality manager, Harold Jansen, says that while the outstanding quality of the IWIP courses is not doubted by the local industry, it is abundantly clear that industry wants the SAIW courses to once again play a major part in the SAIW Inspectors programme. "We have heard them and it makes absolute sense. After all, these are courses that were developed in conjunction with local industry with content that is absolutely pertinent to South African conditions and local industry characteristics."

After deep analysis and research, and taking into account the needs and desires of the local industry, the SAIW has launched a new, improved Inspectors programme, which ingeniously incorporates both SAIW Levels 1 and 2 with the IIW programmes.

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Message from Jim Guild

Firstly, the reason I am writing this is that Sean Blake has decided to leave the SAIW to pursue his own interests. I will be the caretaker Executive Director until the position is filled on a permanent basis. We are currently advertising for the post and if you think you may be the right person please see the advert on our website and make the necessary arrangements.

We have made an important change to the Inspectors programme, which has been for many years the flagship programme of the SAIW. We have decided to bring back the ever-popular SAIW Level 1 and Level 2 courses into the mix. This will render the programme more relevant both internationally and, importantly, locally. Please read all about in our lead article.

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Answering the urgent need for a good career …
… SAIW Open Days will play an important role

As part of its strategy to promote welding as a career to the youth of South Africa, the SAIW has put into motion a series of Open Days to enable young people who are in the process of deciding what to do with their lives to see what welding and its related technologies can offer them.

The first Open Day was held with great success in Johannesburg on the 11th January 2019 with Cape Town and Durban to follow in the near future.

According to the SAIW caretaker executive director, Jim Guild, there is little doubt that one of the most pressing global issues for young people is finding a solid, fulfilling and financially rewarding career. "In a country like South Africa, where the unemployment rate is amongst the highest in the world, and job opportunities increasingly hard to come by, this issue is perhaps the most urgent of all," he says.

WE HAVE CALLED WELDING THE 'MIRACLE CAREER' BECAUSE OF ITS ABILITY TO PROVIDE EMPLOYMENT BOTH LOCALLY AND ABROAD WITH RECENT SURVEYS SHOWING, FOR EXAMPLE, THAT MOST OF THE PEOPLE WHO SUCCESSFULLY COMPLETE AN SAIW COURSE GET EMPLOYED IN A STABLE JOB.

But, he adds, all is not lost! "Welding, being the foundation of almost everything that is manufactured, constructed or built, constantly requires welding professionals to operate in a vast range of industries including the construction, automotive, oil and gas, aeronautical, shipping, power generation and more. In fact, the welding industry is pretty much the perfect hedge against recessionary economies in terms of its ability to provide employment.

"We have called welding the 'miracle career' because of its ability to provide employment both locally and abroad with recent surveys showing, for example, that most of the people who successfully complete an SAIW course get employed in a stable job," Guild says.

Open Day Initiative

The first 'experimental' Open Day in Johannesburg was a rip-roaring success with nearly 50 young people attending. "The response was better than we expected pointing to the need for young people to gain first-hand experience of what the welding industry can offer in terms of a career," says Guild.

He adds that experiencing at close quarters the wide range of career possibilities in welding helps to counter the stigma that welding is a low-paying 'backyard' activity for fixing gates and burglar bars. "Nothing could be further from the truth," Guild says. "In the three broad categories of Welding Inspection and Technology, Non-Destructive Testing, and Practical Welding there are a host of different complex, high-end specialities to choose from enabling young people to find a career in something that suits their individual interest and temperament … and make a good living!"

All participants were given a chance to, inter alia, make a weld, see a robotic welding machine in action, see the processes involved in a host of non-destructive testing techniques and to witness some of the activities in the SAIW's state-of-the-art Materials Testing Laboratory.

Dennis Randall demonstrates submerged arc welding to a group of Open Day Attendees.

The response from the participants was, as expected, enthusiastic.

Brian Phungwayo said: Excellent Day! Very Informative. Made me very interested to find out more about welding as a career.

Bonisile Isaac said: Wonderful, informative. Wish we had had even more time!

Ishmael Manzini: It was a perfect day. So interesting and exciting. Thank you for giving me the chance to be part of it!

For more information please contact SAIW on 011 289 2100

Major Improvement to SAIW Flagship Programme …

… Welding Inspectors curriculum to again fully include the iconic SAIW Levels 1 and 2

Continued from page 1

Shelton Zichawo, SAIW training services manager says that from a local perspective alone, the advantages of the new arrangement are enormous in that it focuses squarely on national requirements in the development of local competence, and addresses directly the local needs of national skills development. "And, perhaps most importantly, it's what our industry wants," he says.

He adds that by combining the best locally-focused programme with an internationally recognised programme, the SAIW will offer the best of both worlds.

In order to ensure the best possible standards, the SAIW has taken cognisance of the latest industry feed-back and has refined the courses to ensure they are completely up to date with the pertinent technology. "By amalgamating parts of the IWIP programmes with SAIW programmes we have created a world-class product to the satisfaction of the local industry. From the students' perspective they obtain two diplomas simultaneously at each level – one South Africa focused and one internationally focused," Zichawo says.

The new structure of the welding inspector programme is shown in the diagram below.

Upon successful completion of the SAIW Inspectors Level 1 qualification examination, the student will not only be issued with an SAIW Inspectors Level 1 qualification, providing access to the South African industry with this sought after 'feather in your cap', but also with an IWI Basic Diploma, allowing individuals to enter the global market, with an internationally recognised and respected International Institute of Welding (IIW) qualification.

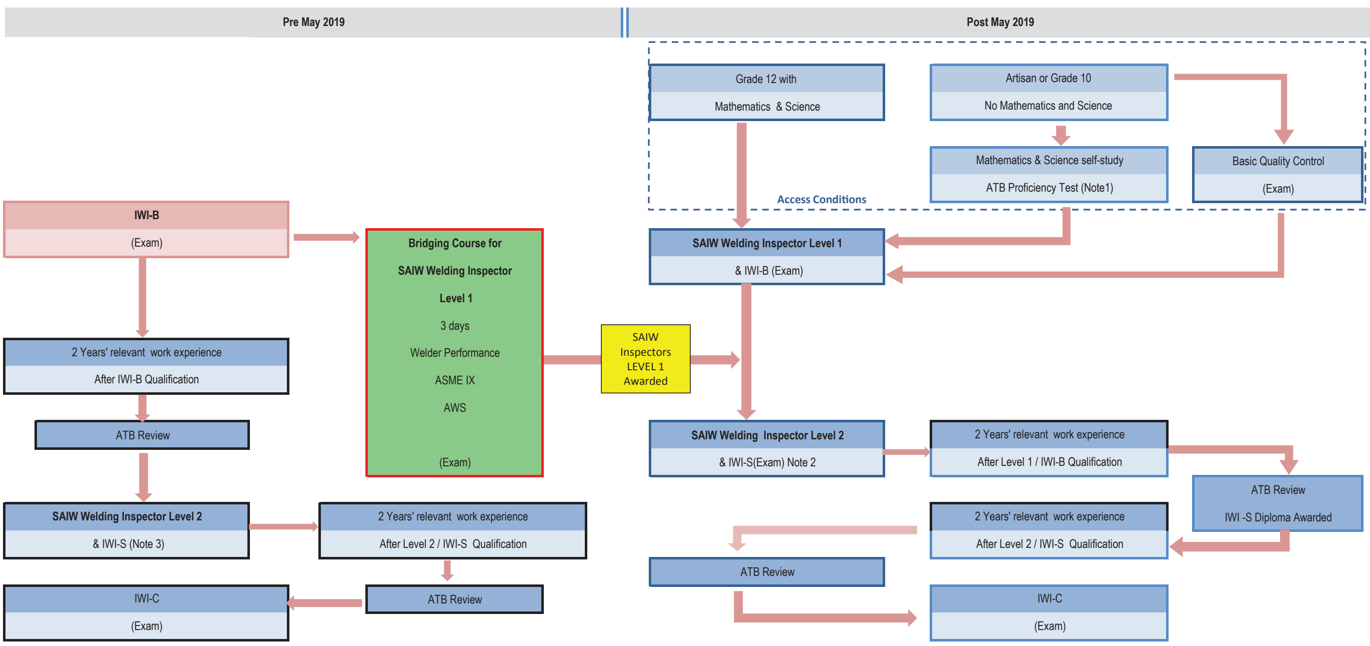
Should students want to go to the next level, after completing SAIW Inspector Level 1 course, they will no longer be required to obtain two years' experience as Welding Inspectors before enrolling for the SAIW Level 2 course. The two years' experience will only come into play should a qualified Senior Welding and Fabrication Inspector (Level 2) wish to obtain the IWIP Standard qualification. "This enables the students to get into the market two years earlier with a higher qualification making them that much more marketable in the industry and more likely to get a higher paying job," says Zichawo.

He adds that the IWIP Comprehensive course, the highest level in the Inspectors programme will remain a stand-alone course in the future.

"A very small number of people may be caught at a crossroad in the progression path," says Zichawo, "and each person will be treated sympathetically and with support from SAIW to ensure they achieve the best outcome for their future."

Anyone uncertain about how they are affected by the changes that are being introduced is invited to speak with any of the lecturing staff or any of the following members of the SAIW staff – Shelton Zichawo, Nico Fourie, Laetitia Dormehl or Michelle Warmback on 011 298 2100.

SAIW Welding Inspector & IIW Qualification Level for Career Progression



Advantages of new Bridging course

This is a fast track to the SAIW Welding Inspector Level 2 qualification.

Note:

(1) Authorized Training Body (ATB). Proficiency test is not required for SAIW Welding Inspector Level 1 **BUT** it is mandatory for IWI –B diploma .

(2) IWI - S Exams completed but relevant experience is required for awarding the IWI -S diploma. Only the SAIW Welding Inspectors Level 2 diploma will be awarded.

(3) Both the SAIW Welding Inspector Level 2 and IWI - S diploma awarded .

Course	Entry requirements
IWI-B International Welding Inspector at Basic Level	Grade 12 (with Math's & Science) or Grade 10 (with Math's & Science) and Basic quality control
IWI-S International Welding Inspector at Standard Level	IWI- B/ SAIW Welding Inspector Level 1 and two years' relevant experience after IWI-B / SAIW Welding Inspector Level 1
IWI-C International Welding Inspector at Comprehensive Level	IWI-S / SAIW Welding Inspector Level 2 and two years' relevant experience after IWI-S/SAIW Welding Inspector Level 2
SAIW Welding Inspector Level 1	Grade 10
SAIW Welding Inspector Level 2	SAIW Welding Inspectors Level 1 or IWI-B with Bridging course or IWI-B with two years' experience and ATB test

SAIW 2019 Welding Challenge standard the highest ever

The 2019 SAIW Welder Challenge competition, which was held from 14-18 January 2019, went off with a bang with more than twenty participants from many parts of the country displaying a skill level unprecedented in this competition. "It once again proved to be the foremost skills test for young welders in South Africa," says SAIW caretaker executive director Jim Guild.

Overall Winner: Stefan Lottering

The overall winner, Stefan Lottering, won a cash prize of R15 000 and joined an illustrious list of winners of this competition, including Thembinkosi Matyeka, Houston Isaacs and Jaco van Deventer, who have gone on to stellar careers in the welding industry.

Guild says that Stefan's effort is a credit to all the youth of South Africa who are involved in the welding industry.

"Like Thembi, Houston, Jaco and many others, Stefan is an example of the wonderful opportunities that welding offers young people who are looking for an exciting and rewarding career. The reason we hold this competition is to encourage young people from all over the country to demonstrate their skill level in welding and to compete against the best the country has to offer. It gives all participants a view of their skill level and motivates everyone to improve," says Guild.

He adds that the SAIW Welder Challenge competition is an industry initiative and would not survive without its sponsors. "We are all grateful that the sponsors understand the continued importance of this competition in terms of encouraging welding as a career for our youth," he says.

Chief Judge Samuel Nguni with his judging panel

The sponsors for the 2019 competition were: CHIETA (main sponsor), Afrox, AFSA, Air Products, ArcelorMittal, Aveng Grinaker LTA, Columbus, ESAB, Lincoln and WASA.

SAIW's Samuel Mnguni, the head judge for the competition, said that the standard of the competition was so high that the results were a close call. "Fortunately, we utilise an objective rather than a subjective marking technique which means we are able to very accurately discern the ultimate winners," Mnguni says.

He added that the increased involvement of those who are teaching the youth welding skills is most encouraging and with their support, the SAIW will continue to extend the footprint of the competition throughout the country. "We are particularly pleased with the participation of TVET colleges and we hope to work even more closely with them in the future."

Some of the participants – many felt that the overall standard of this year's competition was the highest ever.

SAIW's Etienne Nell who has been central to the growth of the SAIW Welding Challenge over the years was also ebullient about this year's competition: "The SAIW biennial Welding Challenge has certainly become one of the premier technical competitions in the country. The standard is always high and the enthusiasm electric - and this year was no different. The 2019 group of competitors was the best yet. It's very exciting that the standard of welding among our youth improves every year."

The competition, which was run strictly along the standards and protocols of the WorldSkills competition, was to find the most proficient welder in three material categories: carbon steel, stainless steel and aluminium using four welding processes: SMAW, GTAW, GMAW and FCAW. There was a prize in each category as well as the overall winner and overall runner-up.

Phased Array Ultrasonic Testing (PAUT) for NDT Inspection, repair and plant monitoring

Introduction

Phased array (PAUT), an advanced method of ultrasonic testing (UT), is widely used for non-destructive testing (NDT) in several industrial sectors, such as construction, pipelines, and power generation. This method is an advanced NDT method that is used to detect discontinuities i.e. cracks or flaws and thereby determine component quality.

A Brief History of PAUT

Phased array (PAUT), made its first appearance in the medical industry in the 1950s for pregnancy scans. A few years later industry realised the full potential of PAUT testing, and began using it to inspect the integrity of manufactured or in-service components and weldments.

Advantages of using PA are as follows:

PA enables inspections to be completed significantly faster than traditional UT, while at the same time collecting and storing substantially more information.

Other advantages include:

- Increased control of the beam characteristics i.e. the beam can be focused and steered.
- Simultaneous inspection with many angles using just one PA probe
- Electronic scanning (rastering) possible without moving the probe
- Complex geometries can be comprehensively inspected
- Limited access areas can be interrogated
- Can replace costly and hazardous Radiography
- Provides us the ability to digitally record inspection data

Example of PAUT's advantages

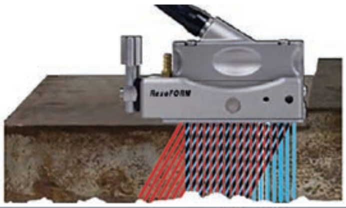
In scanning a butt-weld using traditional UT, several different probes – 0°, 45°, 60° and sometimes 70° angles – have to be used to cover the entire weld volume. One probe will scan the bottom of the weld, another the fusion zone and a third for the weld body and weld toes.

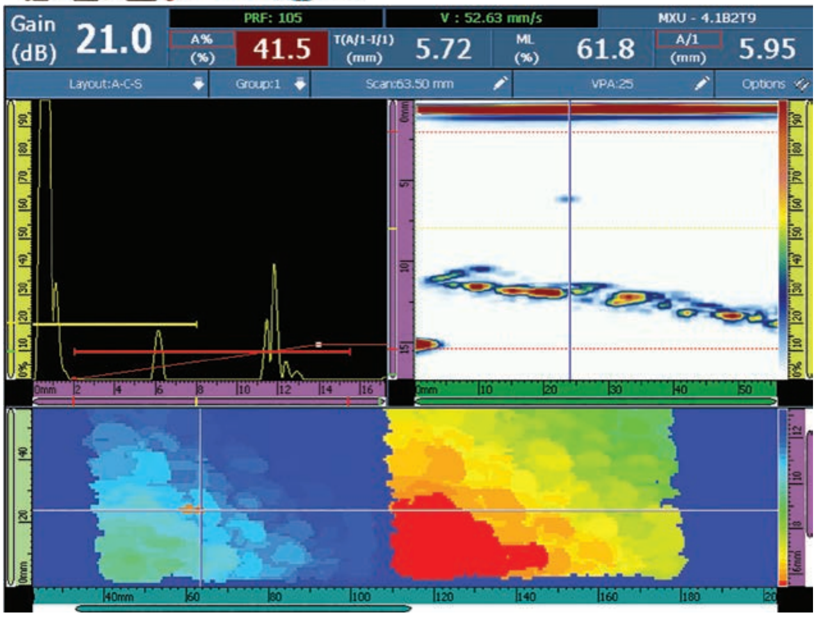
In addition, each probe has to be moved backwards and forwards perpendicular to the weld covering both the half skip and full skip areas – a process known as rastering. This action ensures that the sound beam is directed towards every possible flaw location, at as close to 90 degrees as possible.

With PAUT, a single probe can cover all of these angles and many more from a fixed probe position. The 'rastering' is now conducted electronically with no back and forth probe movement. Now an entire weld can be inspected by scanning (lateral movement) of the probe along the length of the joint, parallel to the weld at a fixed distance from the weld centre.

State of the Art Equipment in S.A.

PAUT equipment in common use in SA is fully digital and incorporates many viewing features (sectorial scan, cross sectional scan "B", Plan view scan "C", amplitude vs distance or time "A" scan,) making the inspection tasks easier. Further, the plate thickness in the case of welded configurations, for example, can be entered into the PAUT unit and one can adjust the probe position on the unit showing the technician the optimum scanning position alongside the weld prior to conducting the test. Simply put, it will show you exactly where to place the probe on the test component. The same can also be applicable to different geometry configurations.





Being digital, PAUT machines can store large amounts of inspection data and their reporting software enables inspection reports to be generated immediately after an inspection is completed. Where required, images of the inspected component can also be embedded into the reports. "The data collected can also be copied onto memory cards for uploading onto computer systems, emailing to clients or archiving for long term traceability.

Differences between PAUT and Traditional UT

One of the main differences between PA and traditional UT is that a traditional UT angle probe only consists of one crystal, which generates an ultrasonic compression wave, and a probe casing, which holds the crystal at the designed steering angle. The different angles are created by mode conversion of the compression waves into shear waves for a more sensitive inspection. Also, different probes are needed for each different angle – typically three or four probes (0, 45, 60, and 70) have to be systematically used to ensure that the full weld volume is inspected.

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Phased Array Ultrasonic Testing (PAUT) for NDT Inspection, repair and plant monitoring

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PA technology replaces the one crystal with an array of crystal elements in a single casing. Probes can have 16, 32, 64,128 or even 256 individual ultrasound generating elements. Some probes, for example, have 64 elements and combinations of these can be made to fire at various angles, which means that, collectively, one PA probe could, theoretically scan an entire weld from a single position.

PAUT is being used more and more, sometimes to replace traditional UT inspections but, increasingly, as an alternative to radiographic inspection (RT). Inside a boiler, for example, boiler tubes were historically X-rayed.

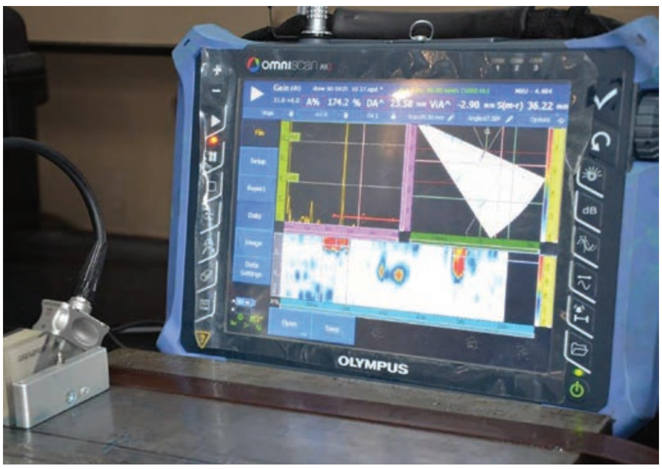
Due to safety concerns, it meant all the welders, grinders and workers anywhere in the vicinity of the X-ray inspection area would have to stop work, down tools and move away to a safe area. Using PAUT, an inspector, welder or supervisor can work side by side. As soon as the weld cools down sufficiently to be inspected, a PA inspection can be completed. The results can be viewed online by the welder, who can see exactly what is going wrong and, if permitted, the problem can be fixed immediately and the weld or welds can be retested.

In terms of the probability of detection, PAUT offers better reliability and sensitivity compared to Radiographic Testing and conventional UT. Often PAUT operators find flaws, such as fine cracks and small areas of lack of fusion, that have been invisible in the past. PAUT testing has been found to be excellent in exposing such imperfections.

Additional applications of PAUT include:

- the inspection of Non-metallic materials and composites e.g. Aircraft parts, bonded materials and composites, disbonds and porosity
- the inspection of Metallic materials e.g. bar, rod, rail, plate, castings and forgings
- discontinuity detection and material integrity evaluations
- complex geometries e.g. turbines, dovetails, rotors, keyways, nozzles, flanges and counter bore can equally be examined using PAUT

FOR MORE INFORMATION CONTACT MARK DIGBY AT SAIW ON 011 298 2100



Focus on standards

ISO/TR 581:2005 Weldability –

For many people in the welding industry, the term or concept of weldability has got different meanings. The volume of source material covering the topic, in various degrees of complexity, is also vast and is continuously expanding due to the amount of research being conducted covering welding technology, materials development, asset management, repair and refurbishment and more.

It is thus clear that the term of weldability is flexible and covers the range from the ability to tack two pieces of metal together without having them come apart, to meeting sophisticated needs of highly technical modern requirements for different applications. Weldability is often hard to define quantitatively, so most standards define it qualitatively as shown, for example, in AWS D1.1/D1.1M:2015.

WELDABILITY IS THE CAPACITY OF A MATERIAL TO BE WELDED UNDER THE IMPOSED FABRICATION CONDITIONS INTO A SPECIFIC, SUITABLY DESIGNED STRUCTURE AND TO PERFORM SATISFACTORILY IN THE INTENDED SERVICE.

A very general, but widely regarded definition for weldability is that it is a measure of how easy it is to make a weld in a particular parent material, without cracks or other harmful defects, with adequate mechanical properties for service, and resistance to service degradation.

For many practical purposes, the weldability of one material is a comparison with another, where the first material is one that has been welded successfully before. However, to quantify the weldability of a material, a series of tests – each specific to one aspect of weldability – is available. For carbon steels it mostly will focus on testing with regards to the various types of fabrication cracking, like solidification cracking, liquation cracking, hydrogen cracking, lamellar tearing and reheat cracking. Also the material chemical composition can play a large role in determining the susceptibility to certain types of defects and hence the connection of the weldability of a material to a calculated value, using published formulas, likes the Carbon Equivalent (CE) value.

The uncertainty which had arisen in the terminology dealing with weldability, and the complex interaction of the various factors influencing weldability, made it necessary to define general principles related to weldability. ISO/TR 581:2005 is a document that defines these general principles that relate to weldability.

- Metallic Materials – General Principles

The word 'Principle' is defined by the Oxford dictionary as *"A fundamental truth or proposition that serves as the foundation for a system of belief or behaviour or for a chain of reasoning."* Weldability is defined in this standard as *"A component consisting of metallic material is considered to be weldable by a given process when metallic continuity can be obtained by welding using a suitable welding procedure. At the same time, the welds shall comply with the requirements specified in regard to both their metallurgical and mechanical properties and their influence on the construction of which they form a part."* Thus weldability is governed by three factors namely, material, design and production. Each of these three factors is associated with different properties, like material properties, design properties and production properties

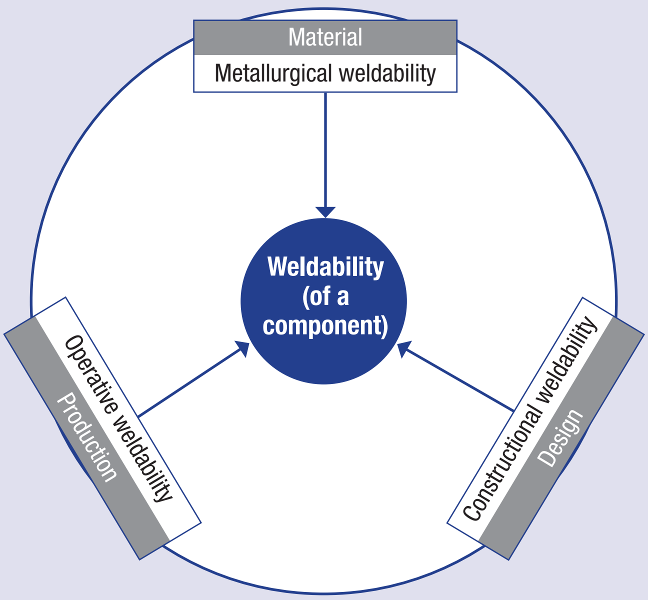


Figure 1: Representation of weldability

Metallurgical weldability (Material properties)

Factors that are governed by the material include, but are not limited to the following:

- Chemical composition
- Properties governed by production methods like deoxidation, hot and cold working and heat treatment
- Physical properties like melting point, mechanical strength and toughness

The less these factors have to be taken into account when determining the welding procedure for a certain construction or component, the better is the Metallurgical weldability of a material, within that material group as per ISO 1508.

Constructional weldability (Design properties)

Factors which influence constructional weldability:

- Design of the construction, for example
  - Notch effect
  - Thickness of the workpiece
  - Force distribution
- Conditions regarding loading
  - Magnitude and type of stresses in the component
  - Temperatures
  - Corrosion
  - Speed of stressing

The less these factors governed by the design have to be taken into account when selecting the material, the greater the constructional weldability of that specific component or structure.

Operative weldability (Production properties)

Factors which will have an influence include the following:

- Preparation for the welding, for instance the type of joint or shop and field welding
- Welding procedure/s
  - Welding process/es
  - Welding consumables
  - Welding parameters
  - Welding positions
  - Preheat and interpass temperatures
  - Precautions needed for area of production (shop or field welding)
- Pre- and post-treatmentt
  - Post weld heat treatment
  - Chemical treatment
  - Mechanical treatment

The less the factors governed by the welding procedure have to be taken into account, in developing a fabrication using a specific material, the better the operative weldability of the intended procedure, is.

Conclusion

When constructions or components are being erected or fabricated, the major task is to achieve the load-carrying capacity required for the purpose of use, and to combine this with adequate security and minimum cost. The weldability of the construction, or of a component, is assured if this is achieved. In order to satisfy this fundamental condition, it is essential to take account of three influencing factors, each of which can be of decisive importance, namely the material, the design and the procedure.

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The previous article (127) explained the basic principles of ultrasonic examination. As to determine accurately the size and position of a feature it is necessary, with any measuring equipment, to calibrate the ultrasonic examination system.

The type of calibration blocks (there are varying shapes and sizes to be used), depend on the application and the form and shape of the subject being tested. The calibration block should be made the same as the material being inspected and the artificially-induced flaw should closely resemble the actual flaw of concern. The best calibration block for calibrating ultrasonic testing equipment is one in the same grade of material and heat treatment condition as the production items and with a weld containing genuine flaws such as slag entrapment, porosity, lack of fusion, cracks etc. Techniques developed enable flaws of known sizes to be introduced into a welded joint. Such calibration blocks can be produced to validate the ultrasonic test method but are expensive and tend to be used only in applications such as nuclear vessel manufacture and critical offshore/process plant fabrication.

A number of standard calibration blocks are available with the shape and dimensions being specified in international standards such as ISO 2400, ISO 7963, ASME V and ASTM E164. Calibration of a compression wave probe used to measure thickness is simple and carried out using a stepped wedge calibration block. These calibration blocks have smooth, machined features and are not therefore truly representative of flaws in a welded component.

For calibrating equipment to be used to interrogate welded joints the calibration block needs to be more complex than a simple step wedge, with probably the two most common types illustrated in Fig. 1, the ISO 2400 Number 1 block and the ISO 7963 Number 2 block. These are machined from steel to very closely controlled tolerances and contain a number of features that can be used to calibrate the ultrasonic equipment. The standard Number 1 block is 300mm long and 25 or 50mm thickness with a 100mm radius machined on one end. The test block also contains two drilled holes, 50 and 1.5mm in diameter and a flat bottomed machined notch.

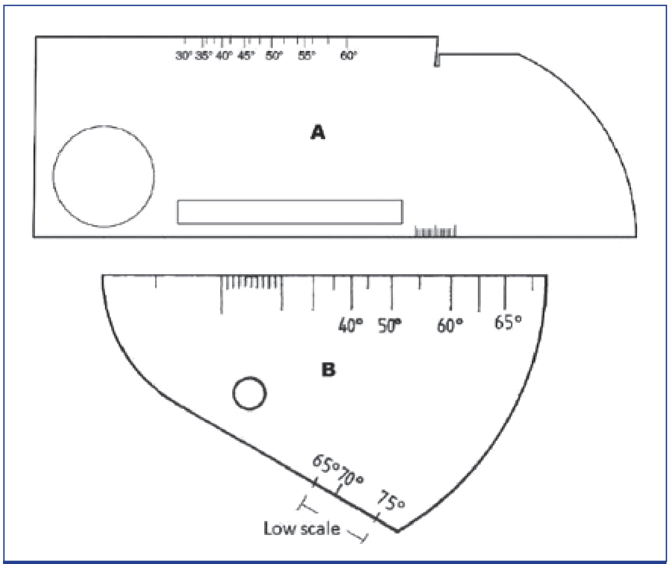

Fig 1: Number 1 and Number 2 calibration blocks

Smaller lighter blocks are useful for site use, and may be used to calibrate both compression and shear-wave probes for beam angle, time base, resolution and sensitivity. Sensitivity and resolution are terms frequently used – sensitivity is the ability to detect small flaws within the weld, resolution the ability to locate and separate individual flaws.

Weld discontinuity acceptance criteria are initially based on the height of the signal displayed on the oscilloscope screen. This is not as simple as it may appear since the ultrasonic beam is influenced by the microstructure of the metal through which it is propagating, becoming scattered and diffused – similar to car headlights in fog! As a general rule the larger the grain size the greater the scattering effect, the reflected beam becomes attenuated or decreased in strength the further away the reflector is from the ultrasonic probe. This must be taken into account when accepting or rejecting flaws within the weld – a 4MHz signal would lose some 0.02–0.03db per mm in steel. Fig 2 illustrates this decrease in amplitude or signal height with distance.

SENSITIVITY AND RESOLUTION ARE TERMS FREQUENTLY USED – SENSITIVITY IS THE ABILITY TO DETECT SMALL FLAWS WITHIN THE WELD, RESOLUTION THE ABILITY TO LOCATE AND SEPARATE INDIVIDUAL FLAWS.

Before calibrating the operator must select the frequency of the transducer as this determines the wavelength of the sound. The frequency has a significant effect on the ability to detect a flaw – a rule of thumb is that a flaw must be larger than one half the wavelength to be readily detectable.

The ultrasonic operator will select a calibration block with some feature of known dimensions, often a 3mm diameter flat bottomed hole and the appropriate ultrasonic probe, these generally being specified in the relevant application code or standard. The height of the reflection at known distances from the probe would be determined and from this data would be drawn a distance amplitude correction (DAC) curve by joining the tips of the signals that can be seen in Fig 2. This provides a means of establishing a 'reference level sensitivity' as a function of distance from the ultrasonic probe and allows the signals from similar reflectors to be evaluated.

The characteristics of an ultrasonic probe vary according to the size of the piezo-electric transducer and its frequency. It is therefore essential that each probe to be used to examine a welded component is individually calibrated and a DAC curve established for each different situation.

The contract specification, application code or acceptance standard specifies the relevant ultrasonic acceptance standard of height, length, position etc of the reflector. It is unwise to refer to a visual or radiographic acceptance standard in the absence of a relevant ultrasonic acceptance standard. An ultrasonic acceptance standard will state which reflectors are acceptable or unacceptable based on the amplitude of the signal compared with a DAC curve or other ultrasonic specific acceptance criteria. One such specification that refers to the DAC curve is ISO 11666 'NDT of welds – Ultrasonic testing – Acceptance levels' which defines four levels:

- the reference level ie the amplitude of the DAC curve at the relevant distance
- the evaluation level ie the amplitude at which the reflector must be examined more closely to determine through thickness height and length of the discontinuity
- the recording level ie amplitude at which the size and position of the discontinuity must be recorded
- the acceptance level above which the discontinuity must be rejected – this may be above or below the DAC curve. Any reflector with a signal below the evaluation level would be ignored

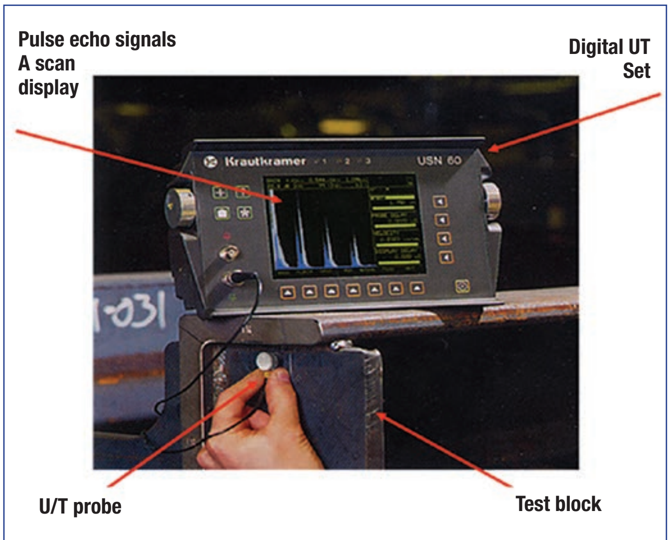

Fig. 2 The reduction in amplitude with distance

If, as the ultrasonic testing (U/T) probe is scanned across the surface of the component, and the amplitude of the signal exceeds the specified evaluation level, the U/T operator would need to investigate the reflector in detail to determine its size, orientation and position within the component. If the probe is moved transverse and parallel to the weld and rotated slightly, a skilled and experienced operator can often identify the flaw type – crack, lack of fusion, etc – by observing the changes in the shape of the pulse-echo on the oscilloscope screen.

To enable the operator to identify the position of a flaw it must be possible for the path and width of the beam to be visualised. Accurately dimensioned diagrams of the weld-cross section superimposed on what would be the beam path are required. This may be unnecessary in many situations but provides additional confidence in critical applications and may be a mandatory part of a written U/T procedure.

The size of a reflector is generally determined by the '6db drop method', as illustrated in Fig. 3.

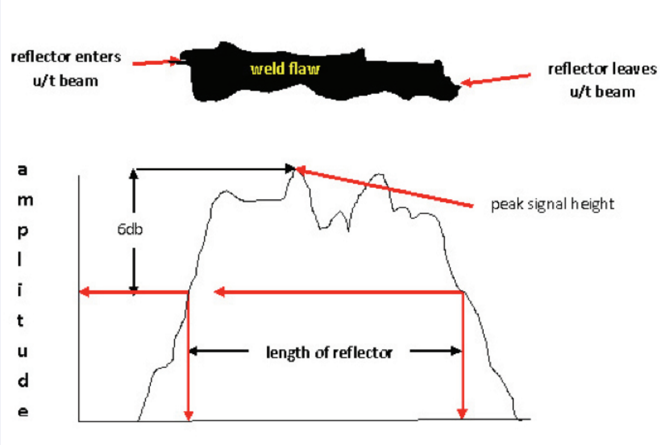

Fig. 3 Schematic of the 6 db drop method for sizling of reflectors

The operator moves the probe backwards and forwards at right angles to the axis of the reflector until the maximum amplitude response is found. This point is noted and the scanning continued until the amplitude of the signal has dropped by 6dB, this point also being recorded. From this the length or height of the reflector can be determined (Fig 3). If above the recording level this would be recorded on the U/T report before being compared with the acceptance standard for either acceptance or rejection.

It is impossible to measure accurately the size of a reflector using a manual scanning technique for a number of reasons. The speed of the sound within the component may vary due to changes in the microstructure and the cleanliness of the parent metal; the probe will be made to within dimensional tolerances, as will the calibration block and these will affect the accuracy of calibration; the beam width may vary; the couplant and surface condition of the component will affect the coupling and hence sound transmission; the surface of flaws within the weld are generally not flat, smooth reflective surfaces oriented at 90 degrees to the beam; the probe movement is measured manually with a rule or tape measure. The most important factors in achieving accurate, consistent and reproducible results are the skill, competence and integrity of the operator.

IT IS IMPOSSIBLE TO MEASURE ACCURATELY THE SIZE OF A REFLECTOR USING A MANUAL SCANNING TECHNIQUE FOR A NUMBER OF REASONS. THE SPEED OF THE SOUND WITHIN THE COMPONENT MAY VARY DUE TO CHANGES IN THE MICROSTRUCTURE AND THE CLEANLINESS OF THE PARENT METAL.

The accuracy of conventional manually-scanned pulse-echo ultrasonic examination carefully performed by a competent operator is around ±2mm. Such inaccuracy can be important when carrying out a fitness for service analysis, where the through thickness of a flaw is of critical importance. Some methods of achieving greater accuracy will be dealt with in the next article.

This article was written by Gene Mathers.

In the SPOTLIGHT

PROFESSOR LESLEY CHOWN

IN EVERY FUSION WE TALK TO SOMEONE WHO HAS CONTRIBUTED SIGNIFICANTLY TO THE WELDING INDUSTRY AND/OR TO THE SAIW. THIS TIME WE FEATURE WITS METALLURGICAL WELDING ENGINEER PROFESSOR LESLEY CHOWN. BORN IN PORT ELIZABETH, PROFESSOR CHOWN LIVED IN EAST LONDON UNTIL SHE WAS NINE AND THEN MOVED TO BENONI, WHERE SHE STILL LIVES.

F: Tell us how your career began

LC: *Engineering captured my interest in high school and I went to Wits University to study Metallurgy and Materials Engineering.* In 1991, after a year in Germany with my husband, on a bursary from Iscor Ltd (now Arcelor Mittal), my career as a metallurgical engineer started at Iscor R&D in Pretoria.

F: How long were you there?

LC: I worked there for ten years, first as an engineer in training, then as a senior engineer. When Iscor unbundled, I joined the Iscor-funded Industrial Metals and Minerals Institute (IMMRI), based at the University of Pretoria in 2000. When our contracts ended in 2002, I moved to Mintek, where I did research on platinum alloys for high temperature use, development of ferrous and titanium alloys, and powder metallurgy of various alloys.

F: Did you do any post-grad work?

LC: My postgraduate research (on prevention of cracking during the continuous casting of steel) was done part-time, starting with a Master's degree in 1997. After upgrading this to a PhD, I went on to graduate in 2008.

F: When did you start at Wits and describe what you have done there?

LC: I joined Wits as a senior lecturer in physical metallurgy in 2011, lecturing undergraduate courses and some of the welding engineering postgraduate courses, and supervising postgraduate students. I have coordinated the Strong Metallic Alloys focus area in the DST-NRF Centre of Excellence in Strong Materials since 2012. To date I have supervised 15 Master's and 7 PhD students, mostly in the research areas of: creep resistant steels for high temperature use, development of titanium alloys and aluminium composites. In 2018, I was promoted to associate professor.

F: How have things changes over the years?

LC: When I started at Wits, we had little state-of-the-art equipment. So, in 2014 Tony Paterson (SAIW Chair in Welding Engineering), Lesley Cornish and I successfully applied to the NRF National Equipment Programme for Gleeble 3500 thermomechanical testing equipment. This facility, valued over R15 million, is an integral part of our vision for welding and fabrication engineering. Apart from high temperature mechanical testing on metals, the Gleeble is designed for welding simulation and post-weld heat treatment under controlled conditions. The SAIW Chair sponsored infrastructure upgrades to house this equipment, and more recently, enabled us to purchase a plasma cutter and welding equipment for SMAW, AC and DC TIG, and pulse MIG, which is currently being installed. I manage these two testing facilities.

F: That's the equipment side. What about the academic programmes and R&D?

LC: Well, we have been building up the Welding Engineering capabilities at Wits, first with Tony Paterson reviving and revamping the 12 postgraduate courses that cover the IIW Modules. In 2018, I took over some of Tony's responsibilities: managing the welding courses and leading the welding research programme, as he is now semi-retired. The broad aim of our research is to link the microstructural effects caused by welding to changes in mechanical properties, and ultimately to use various modelling platforms to predict these changes.

F: That's very interesting. In terms of the local welding industry in general, what is the situation?

LC: I think that the local welding industry is in a period of adjustment. Many welders have been trained over the last decade to meet demand, especially in the construction industry. With a downturn in the global economy, and the maturation of local infrastructure projects, many South African companies have had to downsize. One effect is that spending on further education and training has been reduced. While this may make financial sense in the short term, this will be detrimental to the manufacturing and construction sectors over the medium and long term.

F: And the role that the SAIW plays?

LC: The SAIW plays a critical role, as it provides not only training to welders, inspectors, and postgraduates (through Wits and University of Pretoria) but also the accompanying international accreditation through the IIW. This ensures internationally accepted standards which are available throughout the local industry. Our link with the SAIW enables students to do applied research on industrially relevant projects.

F: Tell us a bit about your personal life

LC: I have been married to my husband Graeme for 28 years, and we have two sons: Matthew (21) and Darren (18) – both studying engineering! I enjoy hiking, especially in the Drakensburg and along our beautiful coastline. At home I relax by doing some gardening, and I dabble in painting, mosaics and poetry. I also sing and play acoustic guitar in our church worship team.

F: Thanks Lesley.

Message from Jim Guild

Continued from page 1

Meanwhile 2019 has begun with a bang. We had a very successful Open Day in January where more than 50 young people came to the Institute to learn about the opportunities that welding offers in terms of a career. We will be focusing heavily in the future on showing school leavers and others the advantages of making a career out of welding and related industries. It is, after all, the 'miracle career' suitable for all levels of personnel and, in addition, our stats over the years show that the majority of people who complete a course at the SAIW are able to find employment in solid, well-paying jobs. Our courses are internationally recognised enabling our graduates to look locally and globally for work

Also, in January, we held the biennial SAIW Welding Challenge which attracted more than 20 young welders from all over the country. The standard was exceptionally high with many of the judges saying that this was the best overall standard in the history of the competition. Well done to all those who competed and to the winners and runners up. You are proof of the potential for young South Africans to be as good as any other welders in the world.

This competition is an important event in the South African welding calendar and we must pay tribute those sponsors who make it possible. This year the sponsors were: CHIETA (main sponsor), Afrox, AFSA, Air Products, ArcelorMittal, Aveng Grinaker LTA, Columbus, ESAB, Lincoln and WASA. Thank you all for your generosity. You are all playing a major role in the development of welding in this country, especially for our youth, and we are deeply grateful.

It is obviously no secret that we are living in very challenging economic conditions in South Africa, but, with the coming elections over, things will improve (the JSE, for example, has shown significant growth since the beginning of the year). So, the SAIW remains positive. We have world-class programmes which can afford young people in this country great opportunity for making a good living even in these challenging times. We also offer those already in the industry the opportunity to uplift themselves in their careers by improving their education and their remuneration. I invite you all to go the SAIW website to see the wide variety of courses we offer. There is something for you!

Hope you all have a great year and please don't forget to contact us should you want to know anything about Fusion or the Institute generally.

Jim Guild
Caretaker Executive Director

The SAIW Welding Fabricator Certification Scheme (ISO 3834)

The ISO 3834 certification of fabricators in South Africa has become one of the most successful initiatives of the SAIW, SAIW Certification and welding industry as a whole in South Africa.

We are taking this opportunity to remind fabricators and construction companies what this is all about.

SAIW Certification, the certification division of SAIW, is authorised by the International Institute of Welding (IIW) to operate its Manufacturer Certification Scheme in South Africa. SAIW Certification was the first organisation outside Europe to receive such authorisation.

Locally the scheme, which is suitable for both manufacturing workshop and construction site activities, is known as the SAIW Welding Fabricator Certification Scheme. It is based on the ISO 3834 standard – Quality requirements for fusion welding of metallic materials – and certified compliance means global recognition of a company's capabilities.

SAIW Certification CEO, Herman Potgieter says it clearly: "ISO 3834 is the basic quality benchmark in our industry and ISO 3834 accreditation officially confirms for all who achieve it that that they provide a world class service," he says.

Potgieter adds that ISO 3834 accreditation is not only an affirmation for the 'outside world' that an accreited compnay is a thoroughly professional organisation, but it is also an internal affirmation. "It is important for every company to get an objective statement about its quality. No matter how big or small one's company is, one can fall into bad habits without realising it. So independent verification of one's standards is vital," he says.

DWK Engineering recently attained its ISO 3834 accreditation

For Big and Small alike

There was a time when the industry felt that ISO 3834 accreditation was for the biggest companies only. Of course this is not true and the number of companies, both big and small, applying for accreditation continues to grow exponentially in South Africa.

"This is an excellent thing as compliance with ISO 3834 ensures that the end-users know who they are dealing with," Potgieter says.

Meet the SAIW Team

We'd like you to get to know the SAIW better so you can see what we do and how well we do it. There's no better way than through the stories of our people. First up is Harold Jansen, SAIW's Systems and Quality Manager.

Harold Jansen

As the Systems and Quality Manager at the SAIW, Harold Jansen is responsible for compiling, establishing, controlling, monitoring, implementing and maintaining the quality management systems of both SAIW and the separate certification company, SAIW Certification.

Systems and Quality functionality, being objective in nature, is a cross-company service provided to both SAIW and SAIW Certification and is consequently organised under Head Office operations. importantly, the functional control of the various processes is the responsibility of the individual service managers within both companies.

Jansen's career at the SAIW started in January 2010 and almost from the get-go he found himself at the front-line of Non-Destructive Testing training, qualification and certification, and ensuring the correct implementation of the SAQCC-NDT, the national qualification and certification scheme administered by the SAIW Certification

One of his career highlights at the SAIW is that, with his involvement, the SAQCC-NDT, being SANAS ISO17024 accredited since 2005, became the first certification scheme developed by Africans for Africans to achieve the prestigious ICNDT MRA Schedule 2 registration. This facilitates the acceptance of personnel qualification and certification from fellow-registered personnel certification bodies world-wide.

Jansen says that quality means doing something correctly, the first time. "Systematic processes ensure that these correct actions can consistently be performed regardless of who or where you are," he says.

He adds that records justifying each process and constant measurement provide motivation that quality is maintained and accreditation through the National Accreditation Body, SANAS, then provides the platform for national service delivery.

"More importantly, though, are SANAS agreements with the International Accreditation Forum (IAF) and the International Laboratory Accreditation Cooperation (ILAC) which allow accredited organisations to actively participate in the global market by ensuring that products or services provided are comparable worldwide," Jansen says.

Starting his career via an Eskom bursary in the early '90s, Jansen ultimately graduated as a solid-state physicist, which he says was a perfect background for integration in the SAIW world. Furthermore, his stints at African NDT Centre, Automated Engineering Solutions and NDT Engineering, exposed him to various industrial sectors ranging from power generation, petrochemical to marine, mining and transport, all of which has been invaluable in his work at the Institute.

"My choice to join the SAIW was the one of the most important in my life. I enjoy working with the people here and especially the students as I love to get involved at the root level to help resolve the myriad challenges confronted in the process of education. We really change lives here," Jansen says.

Jansen is married to Retseh, a grade one teacher, and they have a fifteen-year-old son, John-Henry, who literally has his head in the clouds since he is a national trampoline gymnast and wants to become a commercial pilot when he leaves school.

FOR MORE INFORMATION PLEASE CONTACT HAROLD ON 011 298 2100

AMSA/Foundation Students on the go

The group of Arcelor Mittal South Africa (AMSA) welders who are currently busy with the QCTO approved Registered Occupational Qualification (Welding) are going full steam ahead. While the SAIW Foundation is financing the programme, AMSA are supplying all the materials required for the course.

AMSA, SAIW and the SAIW Foundation is in a three-way partnership to promote skills development in the field of welding, promote welding as a career and support and develop the QCTO artisan welder curriculum.

"We are delighted to be part of this. It is such an important aspect of the future of welding in South Africa," says SAIW's Etienne Nell.

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