

Reeflex Welding machines: made in SA for African mines

African Fusion visits the Randburg manufacturing facilities of Reeflex Welding (Pty) Ltd and talks to the company's founder and managing director, Dr Philip Theron, and marketing manager, Mike van den Berg, about this pioneering local manufacturer of IGBT-based inverter welding machines.



With a significant presence in Africa, Reeflex welding has manufactured and sold around 50 000 inverter welding machines since its inception in Randburg, South Africa in 1996. "We focus on expertise, making better machines for use in the harsh conditions of African mines," begins Philip Theron, who joined Reeflex Welding nearly 30 years ago.

"In South Africa today, there are many different inverter-based welding machine brands. The better ones such as Fronius, Miller, Kemppi, ESAB and Lincoln are now very reliable, but this comes at a cost, while the cheaper brands are typically unreliable and poorly supported, which leads to losses.

"We offer ruggedised machines designed to be ultra-reliable in local African conditions, which we know and understand. And these are simple and affordable machines, mostly for stick welding, but we also do MIG/MAG, TIG and multi-process units with advanced processes features," adds Mike van den Berg.

"Philip's designs have allowed us to

create unique markets in mines all around Africa. In spite of the fact that all of our welding machines are inverter based, ours are as reliable as any premium brand in the world," he adds.

Philip Theron began designing power inverters while still at university in the early 90s. He completed an MSc degree on AC-drives/frequency converters, using IGBTs for soft switching at high frequency. He then went on to add a PhD degree on the use of the new technology for battery chargers, using DC to DC conversion to accurately vary and control charging current levels.

"With my first MMA welding inverter, I won the 1994 Schneider Electric Design Award for being an early adopter of the use of power electronics and IGBTs (integrated gate bipolar transistors) in high frequency transformers.

"In power electronics at that time, most notably for battery chargers and welding machines, IGBTs were beginning to offer the high-speed switching abilities closer to those of MOSFETs, along with the high-voltage and current handling capabilities

of bipolar transistors. They can handle very large currents with a very low gate current drive," Theron explains, adding that he became involved in the design of IGBT-based inverters at an early stage of the technology evolution, which has since significantly reduced the size, improved the efficiency and the added advanced functionality to almost all welding machines.

In the early years, Theron recalls the introduction of an EWS inverter from Italy into the South African Market. "These used IRFP450 MOSFETs (metal oxide semiconductor field effect transistors), and I used to repair EWS machines for Afrox. I learned a lot about what breaks an inverter and the good and the bad aspects of welding machine designs through this process," he tells AF.

The power side of an inverter is just the engine, he explains. It takes the 50 Hz ac mains supply, converts it into high-voltage dc using diodes and a capacitor bank, then, via the inverter, it 'switches' this dc power to create a high frequency ac signal. This enables a much smaller transformer to be used to change the high voltage, low current mains supply into the high current, low voltage power needed for welding. This high-frequency transformer also provides electrical isolation.

In addition, changing the gate on time of the IGBT, allows the welding power to be accurately controlled: the longer the gate time per cycle, the more power is delivered. This enables the delivered arc power to responsively react to arcing conditions to improve welding performance, Theron explains.

"The design is the critical starting point, though, as is the choice of the critical power components, most notably the IGBTs and the capacitors. We tend to buy the best IGBTs we can get. Where most machines might prefer 400 V capacitors, we go for the 450 V and our preferred temperature rating is for 105 °C, where many other



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machines will go for a temperature rating of 85°," he says.

And because these components in our design are interchangeable, we are constantly on the lookout for a better option for reducing our costs without compromising the reliability of the design," he adds.

Welding, Theron continues, involves regular dead shorts of the electrical power, so it is a really good test for the control electronics used. "Our control system is faster than many others. When a welding electrode first strikes or gets stuck onto the plate, the control system can react within 100 nanoseconds, so from a 200 A current, the output might shoot up to 240 A in that short time, but it will quickly be brought back down again and, should the short circuit continue, the control system will drop the current down to about 30 A.

"Even given a lightning strike on the mains supply or an electromagnet pulse, the control side will react to protect the welding machines critical components," he assures.

Describing Reeflex's flagship welding products, Van den Berg cites the single phase 200 A ARC Inverter Welder as the best seller. "And for us, 200 A means a 100% duty cycle at 200 amps. As Philip has already suggested, the unit is built with high quality, mostly European components and the best available IGBTs. Additional features include arc force adjustment and Lift TIG and, being a very popular machine in the mining and industrial sector, a key feature is the VRD, a built-in voltage reducing device that limits the machines open circuit voltage until just before the arc is struck," he informs AF.

Although lightweight and fully portable, ARC welders are heavy duty industrial machines that are ideal for welding repair work using coated electrodes or TIG welding wires. Precise control of the output current and optimised striking voltage

ensures easy starting, low spatter and very smooth running. Also available in this range is a 220 V single phase version and 380 or 525 V three-phase options.

"The aluminium used for our heatsinks all comes from Hulamin, our local supplier, and the sheet metal we use for the chassis and casing is all South African steel. We paint and powder coat the casings in-house, and we assemble the welding cables using locally manufactured cabling from Alvern Cables," says Van den Berg.

Philip Theron adds that all the copper wire for the transformers comes from Wilec, and the transformers themselves are manufactured onsite using winding machines and techniques developed by Reeflex. "Even the small transformers on our PC boards are locally manufactured by AC/DC in Germiston," he informs AF.

"As a result, all Reeflex welding machines comfortably meet the local content requirements of the South African Mining Charter.

For ongoing development, Reeflex actively pursues feedback from customers to upgrade its designs and features. We are now up to Version 6 on our control boards, and changes are ongoing. There is always something that can be improved and as welding process knowledge changes, we can easily add new features to improve the arc stability or to make welding more comfortable for the welder," he adds.

"Going back to the 1990s, though, nothing drastic has had to be changed to reduce repair rates, which have always been very low. We typically only get to repair very old machines or those that have been damaged in accidents. With 50 000 units in operation, months can go by where we don't have to replace a single IGBT," notes Mike van den Berg.



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Theron adds that another key design decision was to continue to use through-hole PC boards for the electronics, which makes it easy for anyone to find a fault and repair it rather than have to replace the whole board with a new one. "We could perhaps make the PC boards smaller by switching to surface mount technology, but there is not much point. It wouldn't allow us to reduce the machine size by much and it would make repair much harder," he says, adding that even Reeflex's shop floor team are able to find a PC-board fault and fix it on the current PC-board design.

Typically offering two-year warranties, Van den Berg says that Reeflex's warranty claim rate is less than 1.0%. "And if a warranty does come in, we often ask the customer to please wait at the counter while we either repair or replace the machine. That's the sort of service that we can and strive to offer," concludes Mike van den Berg.

The full range of Reeflex Welding products are available and supported in South Africa by Bolt and Engineering Distributors (B.E.D.), including: 160 A to 500 A inverters, dual inverters, water-cooled inverters and dual voltage inverters. B.E.D. is also an approved welding repairs centre for Reeflex welding machines, cables and torches.

<https://reeflex.co.za>



Single phase 200 A ARC Inverter Welders being manufactured at Reeflex's Randburg manufacturing facility