# Proven oxygen management solution adapted for innovative WAAM3D printer

## Who is WAAM3D Ltd?

WAAM3D Limited incorporated in 2018, is an academic spin-out company of Cranfield University, where the co-founders have been leading research in the field of large-scale metal 3D printing since 2006.

WAAM3D provides the hardware, software, materials and technology services related to the Wire+Arc Additive Manufacturing (WAAM) process.

WAAM3D has developed cutting-edge WAAM technologies that help their customers create outstanding additive manufacturing (AM) solutions for large-scale industrial metal components as used in the aerospace, energy, marine, and mining industries.

## WAAM3D included in 10 most innovative 3D printing companies of 2022

WAAM3D's years of experience enabled it to design most of the components for the RoboWAAM® printer from scratch, creating an incredibly coherent hardware and software ecosystem.

The best features of RoboWAAM® are the hidden ones: onboard fume treatment, automatic deposition environment purging, quick wire changeover system, and over forty sensors that monitor the key process variables, tens of times per second.

## Issues

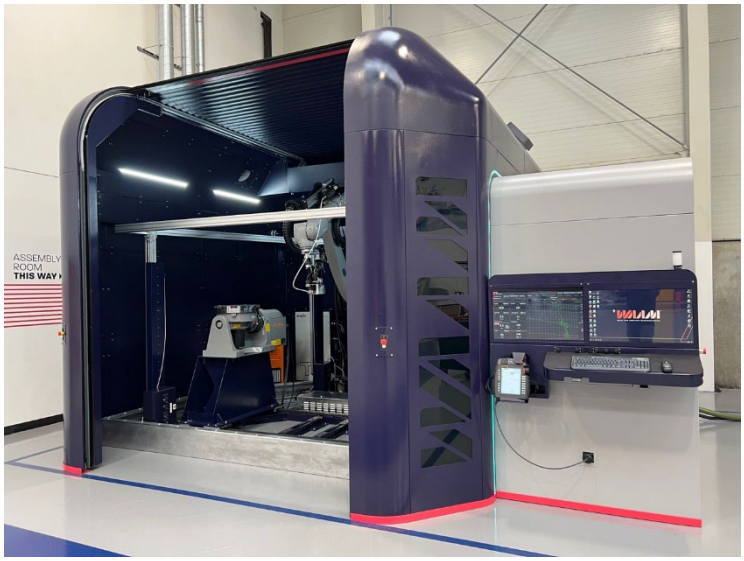
Although the ecosystem was predominantly developed in-house, there were some aspects where WAAM3D used outsourced specialist partners, including gas analysis, to help create the best printer possible.

Preventing oxidisation in the WAAM3D methodology depends on the material being deposited. There are essentially three approaches to oxidation shielding: torch shielding only; local End Effector shielding; and global shielding.

Of these, only torch shielding is normally good enough for materials like aluminium or steel when deposited using some metal inert gas (MIG) variants. When depositing with plasma transfer arc welding (PTA) and working with materials such as titanium, the WAAM3D system has the choice of creating either an inert atmosphere locally (using their proprietary local shielding solutions) which protects the material only where it is above a certain critical temperature; or depositing inside an enclosed global shielding environment which is entirely filled with argon gas. For this approach, having additional oxygen sensors to continuously measure gases over a wider area would provide additional product quality as well as safety benefits.

## The solution

WAAM3D approached Cambridge Sensotec for their AM oxygen gas analyser requirements. Sensotec has been making specialist OEM zirconia gas analysers for AM industry for over ten years. The Sensotec R&D team were challenged to design and build an ultra-compact Rapidox R1100Z-OEM oxygen gas analyser, complete with sample pump and filtration, to fit within a cramped DIN rail cabinet enclosure with limited space availability.




To solve the need for multi-point sampling as discussed above, we also developed a multi-channel variation, the Rapidox R1100-ZR3, with three solenoid valves & amended firmware controlling the sample location. This modified analyser was also presented in DIN rail format for space saving and allowed WAAM3D to continually measure the gases at the End Effector whilst intermittently measuring the wider environment above and below the WAAM deposition all with a single instrument. The analyser was fully integrated into the WAAM PLC software module.


## The result

The Rapidox R1100-ZR3-OEM multiplex gas analyser became an integral part of the cutting-edge WAAM3D RoboWAAM®, one of the most advanced 3D Printing solutions available. Cambridge Sensotec was active in the consultation and development of a complex gas analysis solution specifically designed for this application.

“Cambridge Sensotec was not only happy to consider developing a new product to suit our requirements, but also excited about the project. This was clearly demonstrated by their communication and willingness throughout the project. We now have two of the new Rapidox R1100-ZR3-OEM analysers integrated into our proprietary control system, on 2 different machines, helping to ensure the quality of our large-scale AM parts” - Alex Wright, Development Engineer, WAAM3D.

Mark Swetnam, MD of Cambridge Sensotec added

“Our collaboration with WAAM3D typifies how we enjoy doing business with people. We listened to WAAM3D’s needs and agreed to develop, at our expense, a variation of an existing analyser that was re-designed to fit their needs in terms of space saving and multi-point automatic sampling. The DIN rail sample pump Rapidox is a first for us and we like it so much it has been added to our product line and made available to other customers. That’s a great way of enhancing your product portfolio!”

## WAAM3D Ltd – *‘TCT hardware award winner – June 2022 ’*