

TIG welding for ultra-high purity (UHP) environments

Polysoude introduces some of its advanced Industry 4.0 welding solutions and the role of modern orbital TIG welding for dealing with requirements for maintaining ultra-pure clean rooms.

Whenever high-quality joints are required, GTAW (Gas Tungsten Arc Welding) or TIG (Tungsten Inert Gas) welding, as it is commonly called, can offer an ideal solution.

But a wide range of products have to be manufactured under white-room or clean-room conditions. These products may be susceptible to microbes, as is the case with pharmaceutical ingredients; to contaminations, as seen in the field of micro-electronics; or to foreign objects, which have to be kept out of optical devices and precision mechanics.

In many cases, equipment for use inside clean rooms has to be produced and assembled under a controlled atmosphere as well. Tube networks, for example, are frequently used to supply clean room installations with ultra-pure gases and liquids, which serve to maintain inert atmospheres for etching, rinsing, diluting and injection purposes.

In order to minimise on site work, as many connections as possible for a tube network installation for a clean room supply are pre-fabricated. In the factory; standard components such as micro-fittings, tees, elbows and valves are welded together with matching tube segments. Here, the use of orbital TIG welding can provide significant advantages with complete weld cycles being carried out automatically, leading to consistent, high quality results.

To keep contamination inside a clean room as low as possible, any generation or emission of particles has to be avoided. Sending out an average stream of 100 000 particles per minute with at a size of less than 50 µm, the human body is considered to be one of the most significant particle generators in a clean environment, leading

to workers and visitors in a clean room having to wear protective coverings such as masks, goggles, gloves, galoshes and laboratory coats or work suits.

Manufacturing processes can also be the origin of significant particle emissions. Each electric arc struck during a TIG welding procedure is accompanied by clouds of vaporising metal and streams of weld shielding and backing gas. Additionally, the released heat provokes turbulences between the inert gas and surrounding air, which entrains undesirable pollutants.

However, this can be avoided. Closed orbital welding heads were initially invented as fast and efficient tools for the numerous butt weld connections on aeroplane hydraulics. Ease of use, productivity and outstanding weld quality were the targets for the development and, ultimately, all of these were met in full.

Subsequently, the advantages of an arc burning inside a closed chamber were exploited for clean room purposes. Hot surfaces, turbulence, radiation, uncontrollable particle emission – the entire suite of inconveniences provoked by an open electric discharge – can be eliminated. Today, closed orbital TIG welding heads have become indispensable tools whenever tubes and accessories have to be welded together under clean room conditions.

In order to achieve the best possible benefits and the widest range of applications, the welding equipment should be developed and designed especially for specific clean room requirements. A smart welding station should be installed to supply and control the entire range of closed orbital welding heads for all of the important tube diameters.

Due to their very low weight, these heads can be moved by the operator without any hoisting equipment, which is important for minimising human effort and room infrastructure. The welding equipment should be kept independent from the power source, which can be housed outside the work area. If a liquid cooling circuit becomes necessary for larger tube diameters or improved productivity, this too can be independent of the welding



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power source and located away from the weld area.

Recent Industry 4.0 developments with respect to digitalisation, connectivity, communication and traceability can also be incorporated. This applies to both the data exchange between the different components of the equipment and the internal network of the factory.

Operators who work in a clean room environment have to face a lot of restrictions. Heavy work is forbidden, visual fields are obstructed by masks and their tactile senses are reduced by gloved hands. Professional welders need only manage the conditions of their equipment before starting a weld cycle. If working under a controlled atmosphere, this should be made as easy as possible. With a barcode scanner, which may be wired or wireless, the QR-code on a work suit can be scanned to identify the responsible operator. In the same way, the welding head, welding gas and workpiece can be identified. The required welding programme is then selected via a tablet, while any additional inputs can be added, even by an operator wearing gloves.

Preparing the weld is divided into two parts: fixing of the workpiece into the clamping unit of the welding head, and final positioning of the welding head with its motor, gear track, supply hose, etc.

Once initiated, the real-time progress of the weld cycle can be watched on the tablet and recorded, while real time welding parameter values are displayed. This data is also transmitted to the connected network at the same time.

On completion of a weld and a visual inspection, the operator can immediately confirm the successful production of a joint that has been completed without compromising the cleanliness of the UHP environment. ■



Polysoude closed chamber welding tools for use in the UHP industry.