

Orbital welding in High and Ultra High Purity environments

There is rising global demand for semiconductor-based devices. These are manufactured under strictly controlled conditions in clean-room facilities connected to gas, liquids, steam, and water supplies through welded tubes. How to ensure these welds meet stringent regulations?

Text & images by Polysoude

The market of semiconductor-based devices is currently subject to dynamic changes. Rising demand is generated by accelerated digitalisation trends, artificial intelligence development, supercomputing, and the Internet of Things. In the course of ongoing technical evolution, global players like Intel, Samsung or TSMC are preparing the commercial production of 3 nm semiconductor nodes, and IBM has recently presented their prototype of a 2 nm chip. To reduce their dependence on global semiconductor supply chains, Chinese firms with techniques that remained far behind the level of leading global companies now try to get away from acting as pure-play foundries.

Growing demand means that existing production facilities must be expanded and new semiconductor fabrication plants built. Successful fabrication of semiconductors and semiconductor manufacturing equipment will require many additional clean room facilities which comply with Ultra High Purity (UHP) standards.

Under the impact of the global pandemic, new pharmaceuticals are currently being developed and produced. The required capacities, especially for the huge number of Covid-19 vaccines, depend on advanced clean room technology with UHP or at least High Purity adequacy.



Figure 1. Smart Welding Station P3 UHP with closed chamber welding head for orbital welding of tubes and fittings.

These trends prompted the French company Polysoude to launch the Smart Welding Station P3 UHP (Figure 1) at the beginning of 2021, with only 16 months lead time.

Stringent regulations

In the field of semiconductor production, an extended tube network is necessary to supply cleanroom installations with ultra-pure gases and liquids, which serve for inertisation, etching and rinsing. In contrast, the preparation of pharmaceuticals depends on steam and germ-free water for sterilisation, diluting and

injection purposes. The high-quality tubes for the network assembly are usually connected by welded joints which must meet extremely stringent provisions.

Cleanroom equipment manufacturers and suppliers of related components like tubes, valves, fittings etc., execute these welds in their workshops, whereas cleanroom builders who mount the final installations must carry out the welds on-site (Figure 2). Regardless, the required joint quality can only be attained if all the welds are manufactured under cleanroom conditions.

[WELDING]

The ultimate goal of the P3 UHP concept was to make available specific welding equipment exclusively designed and intended for cleanroom purposes. The end-user of a cleanroom facility understands the quality of the joints has direct consequences on the results of his production, so he expects perfect welds proved by complete and reliable documentation. The subcontractor who carries out the welds ensures that his welding equipment offers all prerequisites to complete the required UHP and HP jobs satisfactorily.

Smart solution

The Smart Welding Station P3 UHP fulfils these tasks with welding heads UHP 500 or UHP 625. These orbital TIG welding heads produce joints of unrivalled quality without cracks, pores and roughness. Their closed chamber provides perfect gas protection to avoid heat tint of the tubes and reduced particle emission to keep the cleanroom clean. The gas-cooled UHP type welding heads allow autogenous welding of thin-walled tubes with diameters between 1.6 and 6.35 mm. As precision welds require precision adjustment, the welding current can be programmed in steps of 1/10 A.

Weighing only 17 kg, the power source P3 UHP is the lightest automatic welding station on the market. It can be carried without hoisting equipment,

which is comfortable in the workshop but especially advantageous if used on site.

Water cooling is not desirable in cleanroom environments, and it is not necessary to operate UHP type welding heads. However, if improved performance is required or tubes with diameters up to 170 mm have to be joined, water-cooled closed chamber welding heads of the MW type become the tool of choice, and a separate cooling unit can be added. Finally, other orbital welding heads from Polysoude or even other suppliers are supported as well.

Automatic welding guarantees the best results if the related procedures are thoroughly respected. The Smart Welding Station has several unique features to support the operator. A Wireless Touchscreen Controller (WTC) offers substantial advantages concerning ergonomics of use; for example, flexible access to one or several Welding Stations and their related welding heads (Figure.3). The set values of the mass flow meters for welding and backing gas are displayed on the screen, and the software-controlled flow rates can be adjusted precisely.

The operator authorisation, welding gas type, and the workpiece's identity are quickly determined by a bar code scanner that transmits the data to the welding station via WiFi or by cable. During connection to the power



Figure 3. Wireless touchscreen controller to pilot one or several welding installations.



Figure 2. On-site installation for medical gas lines in a hospital.

source, the type of welding head is detected automatically. Matching Welding Procedure Specifications from the inbuilt WPS library appear on a LAN/WLAN based touchscreen controller, which can be used as well to add necessary data. After the welding head has been correctly positioned, the weld cycle can be started and controlled either by the touchscreen or by a remote-control pendant, a laptop via LAN or WLAN or on the welding head itself. The real-time progress of the weld cycle is displayed on the screen, and the momentary welding parameter values are listed at the same time. After the end of the cycle, a welding report is immediately at hand by means of the integrated printer. For traceability and quality assurance, the data can also be transferred to the company network by LAN or WLAN; the DHCP WEB protocol is supported. Furthermore, the Smart Welding Station P3 UHP is prepared for Smart Factory application; it interfaces perfectly with the Industry 4.0 process and the related OPC-UA protocol. Together with the wide range of available accessories, the Smart Welding Station P3 UHP eases the operator's tasks, with different configurations allowing the user to customise the equipment to UHP and HP environments.