

Precision Systems for the ISS

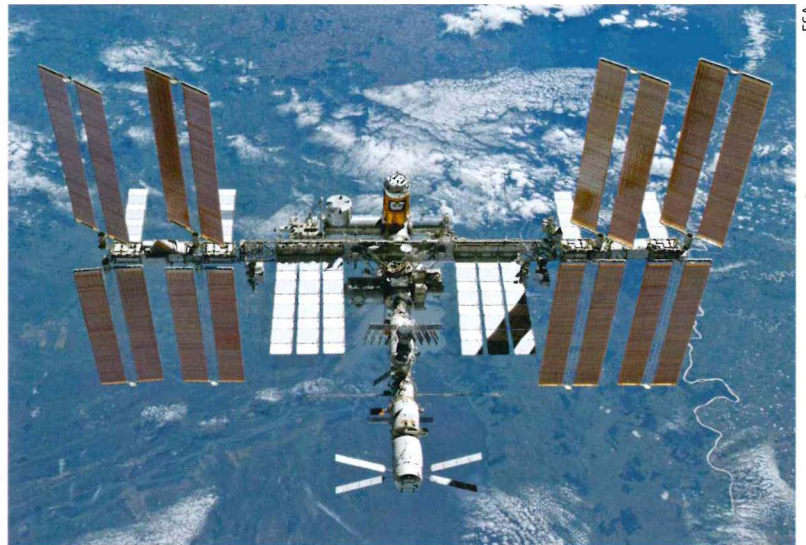
Supply systems for water, carbon dioxide and oxygen management on board of the International Space Station (ISS)

Burkhard Speth

Last year, PINK GmbH Vakuumtechnik, Wertheim, completed the final important subassemblies for the novel Advanced Closed Loop System (ACLS) and supplied it to Airbus Defence & Space. With final assembly taking place there this year, the ACLS is scheduled for launch to the ISS at the end of 2017.

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The ACLS is a life support rack that will be put to use in the International Space Station (ISS). It contains regenerative processes with the main purposes of separating CO_2 from the cabin air, generating respirable oxygen with the alkaline electrolysis of water, and generating water by means of two-stage methanation in a Sabatier reactor from the process gases hydrogen and CO_2 (Fig. 1). The water generated in the reactor is recirculated into the ACLS's internal water management subsystem and can thus be re-used on the ISS. By introducing the ACLS, the international operators of the space station hope, above all, to significantly



At the end of 2017 a life support system will be installed on board of the International Space Station.

reduce the quantities of water that need to be uploaded to the ISS. Thereby, they want to achieve substantial savings in transport costs for astronaut support.

The overall ACLS consists of seven modules known as drawers that are accommodated in an International Standard Payload Rack

(ISPR). Installed in these drawers are various components, sensors, and lines etc. that, grouped in sections, form various subsystems. The most important subsystems are the Carbon Dioxide Concentration Subsystem (CCA) with the Drawers #1, #2 and #3 for the separation of CO_2 from the cabin air, the Oxygen Generating Subsystem (OGA, Drawer #6) and the Carbon Dioxide Reprocessing Subsystem (CRA, Drawer #4) for the production of water.

In addition to producing individual components for Drawers #1 and #2, PINK was entrusted with the (partial) engineering and production of the technical centrepiece of Drawer #4, the Sabatier reactor. Furthermore, PINK produced the complete Drawer #6 (Fig. 2) – the module for oxygen generation by electrolysis – with all the mechanical connections and pipework ready for installation (plug & play). The electrical wiring was integrated in an intermediate step by Airbus staff in PINK's cleanrooms in close cooperation.



Fig. 1 Assembly work on the Sabatier reactor, the centrepiece of Drawer #4,

the CRA subsystem for generating water and methane from CO_2 and hydrogen.

The contract for the engineering and production of these highly complex systems was awarded to PINK not least on the strength of the customer's trust that the company had acquired from the successful handling of similarly complex projects, such as the EML, a module for materials research under weightless conditions for the European space laboratory COLUMBUS on the ISS.

PINK's manufacturing expertise is based on experience from thousands of already accomplished high-vacuum applications calling for optimum tightness. The company's products and services thus encompass such cutting-edge production processes as electron beam welding and HV high-temperature soldering, without which reliable vacuum-tightness would not be possible, particularly when using special materials necessary for specific applications. PINK

then assembles the precision components fabricated with the tiniest tolerances into high-grade and dependable subassemblies in its own cleanrooms.

What made the engineering and production of the ACLS subassemblies particularly challenging was the fact that the technical preconditions for the separation and chemical treatment processes had to be established in extremely confined space. For the resultant super-compact systems, PINK specially had to develop novel assembly strategies. Thanks to a strict methodical chain of precision manufacture, cleanroom assembly, quality control and documentation, it was possible to successfully conduct integration, tests and (partial) verification of the Engineering Module and Flight Module together with the customers in PINK's cleanrooms.



Propono / U. Hoffmeister

Fig. 2 PINK has manufactured the entire Drawer #6 (OGA subsystem), the module for generating oxygen from water by alkaline electrolysis.

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