



HIGH-PRESSURE, HIGH-FLOW METAL BELLOWS VACUUM PUMPS FOR HYDROGEN ISOTOPE HANDLING

CHALLENGE

The nuclear industry faces unique challenges in handling hydrogen isotopes. Senior Metal Bellows vacuum pumps and compressors have been widely used in these critical applications for over 50 years, due to the unique welded metal bellows technology which is ideally designed for extreme environments where high reliability, zero leakage, and long life are required. As the industry evolves, the demand for higher flow rates, higher pressure designs, and increased mechanical loads on these pumps has grown. In response to these challenges, Senior Metal Bellows was approached to develop a solution that increases our flow rate by 5X while maintaining a helium leak rate of 1×10^{-9} ssc/sec while providing an infinite life design, a standard for all our metal bellows pumps and compressors.

OUR SOLUTION

We took a comprehensive and innovative approach to enhance our existing pump design to address these challenges. By leveraging our extensive historical database of engineered bellows designs and performance ratings, we were able to scale up our existing bellows design to accommodate the increased flow and pressure requirements. To ensure the reliability and performance of the new design, we utilized Finite Element Analysis (FEA) and conducted rigorous testing in our engineering lab to simulate in-service operating conditions. This systematic approach allowed us to develop a final product that not only met, but exceeded the end user's performance and durability requirements.



The resulting product is a double containment pump designed for high flow and high pressure that offers unparalleled performance in radioactive environments, while ensuring operator safety with secondary containment bellows and tertiary sensor bellows technology.



RESULTING PRODUCT FEATURES

Key features of our hermetically sealed all-metal double containment pump:

- **Primary operating bellows**

Designed to withstand the increased mechanical loads and provide the specified flow and pressure requirements.

- **Secondary containment bellows**

Ensures process gas is confined within the pump head, eliminating the risk of leakage and contamination.

- **Tertiary sensor bellows**

Detects and alarms the operator in the unlikely event of a bellows breach caused by upset process conditions, sending a signal back to the plant Distributed Control System (DCS) for timely intervention and maintenance.

- **Infinite life design**

Engineered for long-lasting performance in radioactive environments, reducing the need for frequent replacements and minimizing downtime.

- **Minimal footprint**

Suitable for glovebox installations, optimizing space utilization in confined working areas.

Our engineering team specializes in providing custom engineered solutions with challenging application requirements.



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- **LET'S TALK!**

For any questions or to engage with our technical solution team, please contact us at

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