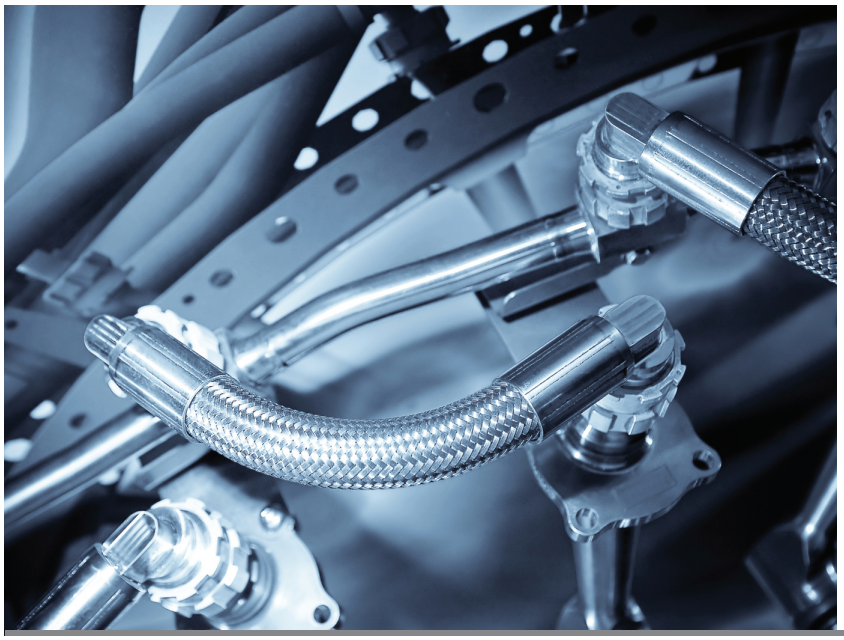

National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Mechanical and Fluid Systems

Low-Cost, Long-Lasting Valve Seal

A simple and new valve seat installation technique for leak prevention

NASA Marshall Space Flight Center has developed a new, simplified method for installing valve seats, eliminating the need for a swaged assembly process and the additional hardware and equipment that are typically found in conventional, elastomeric valve seat installations. In addition to weight reduction, the fewer hardware components reduce the number of potential failure modes. This simplified technique saves time and installation costs, and results in comparable leakage protection by minimizing acute stress in the seal material.

NASA has used the installation technique on gas-fed, pulsed, electric thrusters for propellants, which requires very specific fluid flow operation by quickly opening and closing the valves within short durations of time. The NASA technique is especially advantageous for small instrumentation valves where precise fluid control is essential.

BENEFITS

- Easy installation: simplifies the seat installation process
- Low manufacturing costs: eliminates traditional installation equipment and steps, such as the swaged manufacturing process, saving time and money
- Improved performance: reduces failure mode potential due to fewer material components while maintaining comparable or lower leakage rates
- Scalable: can be scaled up to install multiple seat seals simultaneously
- Lower mass: reduces payload weight

THE TECHNOLOGY

NASA's technique simplifies the seat installation process by requiring less installation equipment, eliminating the need for unnecessary apparatus such as fasteners and retainers. Multiple seals can be installed simultaneously, saving both time and money.

NASA has tested the long-term performance of a solenoid actuated valve with a seat that was fitted using the new installation technique. The valve was fabricated and tested to determine high-cycle and internal leakage performance for an inductive pulsed plasma thruster (IPPT) application for in-space propulsion. The valve demonstrated the capability to throttle the gas flow rate while maintaining low leakage rates of less than 10^{-3} standard cubic centimeters per second (sccss) of helium (He) at the beginning of the valves lifetime. The IPPT solenoid actuated valve test successfully reached 1 million cycles with desirable leakage performance, which is beyond traditional solenoid valve applications requirements. Future design iterations can further enhance the valve's life span and performance.

The seat seal installation method is most applicable to small valve instruments that have a small orifice of 0.5 inches or less.

Beyond aerospace applications, the seat seal technique can also be used in other applications where small instrumentation valve fluid control is required, such as medical equipment.

APPLICATIONS

The technology has several potential applications:

- Solenoid valves
- Check valves
- Manual valves
- Disconnects
- Regulators
- Relief valves

PUBLICATIONS

Patent No: 10,197,165

Burkhardt, W.M., Crapuchettes, J.M., Addona, B.M., & Polzin, K.A. (2015). Development of long-lifetime pulsed gas valves for pulsed electric thrusters. 51st AIAA/SAE/ASEE Joint Propulsion Conference, Propulsion and Energy Forum, Orlando, FL.

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NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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