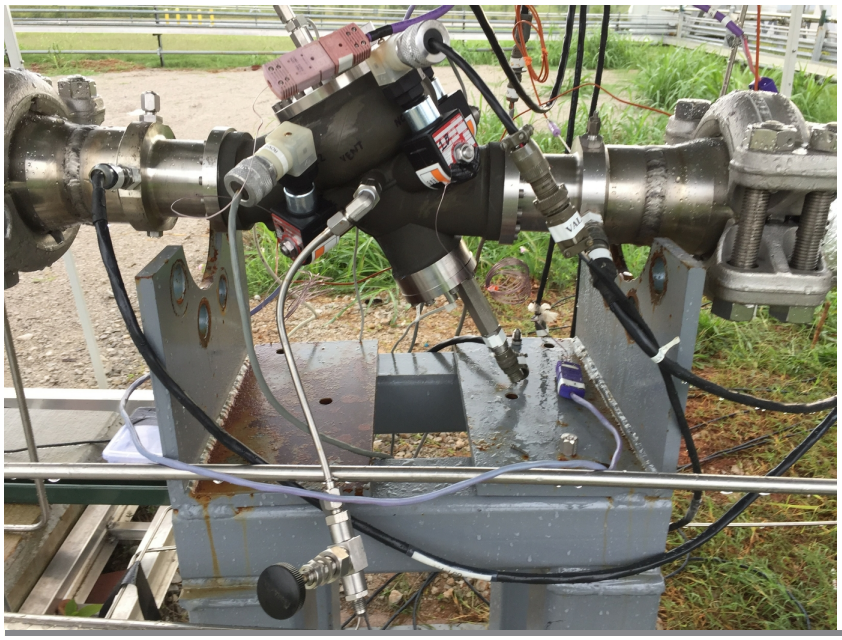

National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Mechanical and Fluid Systems

Cryogenic Hydraulically Actuated Isolation Valve

Actuation requires only upstream pressure and 22-watt DC power supply

Researchers at NASA's Marshall Space Flight Center have developed a cryogenic isolation valve that utilizes the upstream line pressure of cryogenic fluids for actuation. Previously, the use of cryogenic fluids for actuation systems had been too difficult to control and resulted in unsafe operating conditions due to the cryogenic fluid used for actuation being separated from the main body of the valve. Once separated, the cryogenic fluid would heat too quickly and vaporize, resulting in high, volatile pressures. To avoid these issues, cryogenic fluid had historically been controlled and redirected using either electromechanical or pneumatic actuation systems. By using the upstream line pressure of the cryogenic fluid for actuation, NASA's cryogenic isolation valve eliminates the need for the complex support systems that are necessary with electromechanical and pneumatic actuation systems.

BENEFITS

- Requires only upstream line pressure and DC power source capable of 22 watts for actuation, eliminating the need for support systems; reducing footprint, energy consumption, and cost; and reducing weight by up to 63%
- Has no external dynamic seals and no external actuation device
- Contains only one moving flow element
- Designed to be serviceable and rebuilt in-line
- Performed an Oxygen Hazards Analysis (OHA) to guide the design and selection of materials, design volumes, and other necessary criteria to ensure the valve is safe for use in high pressure oxygen applications

THE TECHNOLOGY

NASA's cryogenic isolation valve technology uses solenoid valves powered by direct current (DC) electrical energy to control and redirect the energy stored in the upstream line pressure. Powering the solenoid valves only requires a DC power source capable of supplying 22 watts that can be distributed and controlled in an on/off manner. By achieving actuation using only upstream line pressure and a 22-watt DC power source, many additional support systems that are required for electromechanical and pneumatic actuation are eliminated. This reduction of parts results in several benefits, including reduced footprint, weight, and potential cost of the valve in addition to lower energy consumption.

NASA fabricated several operational prototype valves using this technology for a rocket company. The table below shows the results of tests performed on these valves under cryogenic conditions. Please contact the NASA MSFC Technology Transfer Office for additional information.

NASA's Design Characteristics	
Dimensions	9.75"x10"x10" Valve Inlet to Valve Outlet = 9.75" with 2.5" diameter bolted connections
Weight	28 lbs (commercially available valves for similar application = ~80 lbs)

Valve Testing Performance	
Proof Test	Completed at 1500 psig
LN2 Cryo Shock Test	Completed
Full Pressure Flow Test (LN2 @900 psig)	Cv = 102 (Flow = up to 622 gpm, DP = 28)
Full Pressure Leak Test (LN2 @900 psig)	External leakage: None detected
Full Pressure Leak Test (ambient temp @900 psig)	Internal leakage:1 bubble / minute
Minimum Pressure Flow Test (LN2 @150 psig)	Cv = 102 (Flow = 240 gpm, DP = 4.5)
Minimum Pressure Leak Test (LN2 @150 psig)	External leakage: None detected

The table above shows the design characteristics and cryogenic test data of the cryogenic hydraulically actuated isolation valve that NASA designed and developed.

APPLICATIONS

The technology has several potential applications:

- Commercial Space
- Liquified natural gas
- Air separation
- HVAC refrigerant
- Semiconductor manufacturing
- Pharmaceutical processing

PUBLICATIONS

Patent No: 10,746,132

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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.

MFS-33427-1, MFS-TOPS-94

More Information

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NP-2018-12-2657-HQ