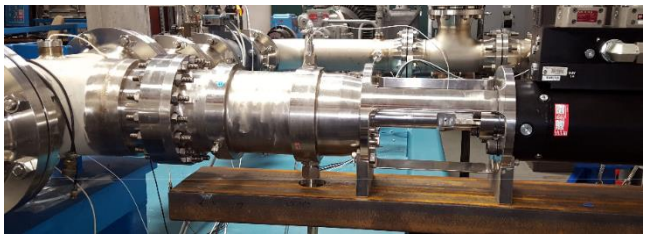
Cold Flow Propulsion Test Complex Pulse Testing

Description

When the propellants in a liquid rocket engine burn, the rocket not only launches and moves in space, it causes forces that interact with the vehicle itself. When these interactions occur under specific conditions, the vehicle's structures and components can become unstable. One instability of primary concern is termed pogo (named after the movement of a pogo stick), in which the oscillations (cycling movements) cause large loads, or pressure, against the vehicle, tanks, feedlines, and engine. Marshall Space Flight Center (MSFC) has developed a unique test technology to understand and quantify the complex fluid movements and forces in a liquid rocket engine that contribute strongly to both engine and integrated vehicle performance and stability. This new test technology was established in the MSFC Cold Flow Propulsion Test Complex to allow injection and measurement of scaled propellant flows and measurement of the resulting forces at multiple locations throughout the engine.



Pulser installed at the MSFC Cold Flow Propulsion Test Complex Pump Test Equipment (PTE) Loop

Success Story

The Space Launch System (SLS) main engine (RS-25) was designed with a pogo suppressor to prevent oscillating forces from being transmitted through the engine and negatively impacting its thrust. In fiscal year 2016, tests of the RS-25 pogo suppressor were performed at the MSFC Cold Flow Propulsion Test complex using the piston type pulser, shown in the image above, to experimentally quantify the suppressor performance. The test successfully validated the RS-25 pogo suppressor model used to demonstrate SLS vehicle stability.

Benefit

Fluid dynamic environments are highly complex and have strong impacts on rocket engine components, and integrated vehicle stability, life, and performance. By providing a test environment that is more representative of the real conditions experienced in flight, this new ground test technology helps NASA experts' gain a better understanding of the complex forces involved with propellants as they move throughout the engine. Data from this testing helps validate analyses and models ranging from those of basic hardware to complex system interactions.

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