

National Aeronautics and Space Administration

LYNDON B. JOHNSON SPACE CENTER
WHITE SANDS TEST FACILITY



PYROVALVE TEST FACILITIES

FACILITY DESCRIPTION

As a part of the NASA investigation following the loss of the Mars Observer spacecraft, facilities were set up at White Sands Test Facility (WSTF) to provide a detailed characterization of pyrotechnically operated valves (pyrovalves) and evaluate potential effects that pyrotechnic blow-by may have on fluid in the propellant system. Testing is generally handled in one of two primary facilities: the Propellant Interaction Test System and the Blow-by and Velocity Measurement Laboratory.

The Propellant Interaction Test System, located in the 800 Hazardous Fluids Test Area, is capable of testing potential pyrotechnic interaction with most common rocket engine propellants such as hydrazine, monomethylhydrazine, nitrogen tetroxide, hydrogen, and oxygen. Additionally, propellants can be saturated with gaseous nitrogen and helium as required to simulate mission conditions. Most propellant system configurations can also be simulated, and the combined effects of hot pyrotechnic blow-by and adiabatic compressive heating can be evaluated.

The Blow-by and Velocity Measurement Laboratory measures valve actuation and ram downstream pressure, temperature, strain, light emission, shock, and blow-by gas and solid constituents. A highly accurate vacuum transducer can detect minuscule increases in downstream pressure. The system uses a mass-spectrometer, residual gas analyzer, and gas chromatograph to identify gases. After actuation, valves are flushed and particulates/solubles are identified by an inductive coupled plasma analyzer and other methods. By installing an optical window in the pyrovalve, ram velocity can be determined using a Velocity Interferometer System for Any Reflector (VISAR). VISAR is a Doppler interferometer that analyzes the spectral shift in laser light with respect to time to make non-intrusive, high-speed velocity measurements.

FACILITY INSTRUMENTATION

High-speed instrumentation and data acquisition systems are available to obtain a wide variety of dynamic and static measurements. The Propellant Interaction Test System is capable of measuring system pressures and temperatures up to a 1 MHz sample rate. Piezoelectric, dynamic, pressures transducers are generally used for gathering high frequency data.

The Blow-by and Velocity Measurement Laboratory system is capable of measuring redundant pyrotechnic cartridge outlet pressures, ram driving pressure, pressure downstream of the ram, reaction light emission, shock, and strain up to 1 MHz. VISAR digitizing is handled by a Tektronix TDS 754A Digital Storage Scope at 500 MHz bandwidth and 2 GHz sampling rate. Redundant data can also be digitized and stored on a high-speed, PC-based data system.

TEST CAPABILITIES

Interactive testing in the 800 area must be limited to a total involvement of 1.9 lb TNT equivalent. However, larger involvements up to 500 lb TNT equivalents can be handled at the High Energy Blast Facility. Systems simulated to date include Telstar 402, LandSat 6, Mars Observer, and Space Station Interim Control Module. Pyrovalve blow-by can be measured in the range of over 100 mg to below 0.01 mg. Ram velocity can be tracked from just a few meters per second to several hundred meters per second.

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