ROCKET ENGINE PERFORMANCE MEASUREMENT

SUMMARY

One of the goals of rocket engine hot-fire testing is to directly evaluate engine performance for the purpose of validating analytical design parameters or flight worthiness. Different performance parameters can be measured depending on customer requirements. The White Sands Test Facility (WSTF) performance measurement capabilities include vacuum thrust, mass flow rate, propellant pressure, and standardized performance parameter calculation for comparison to nominal engine performance.

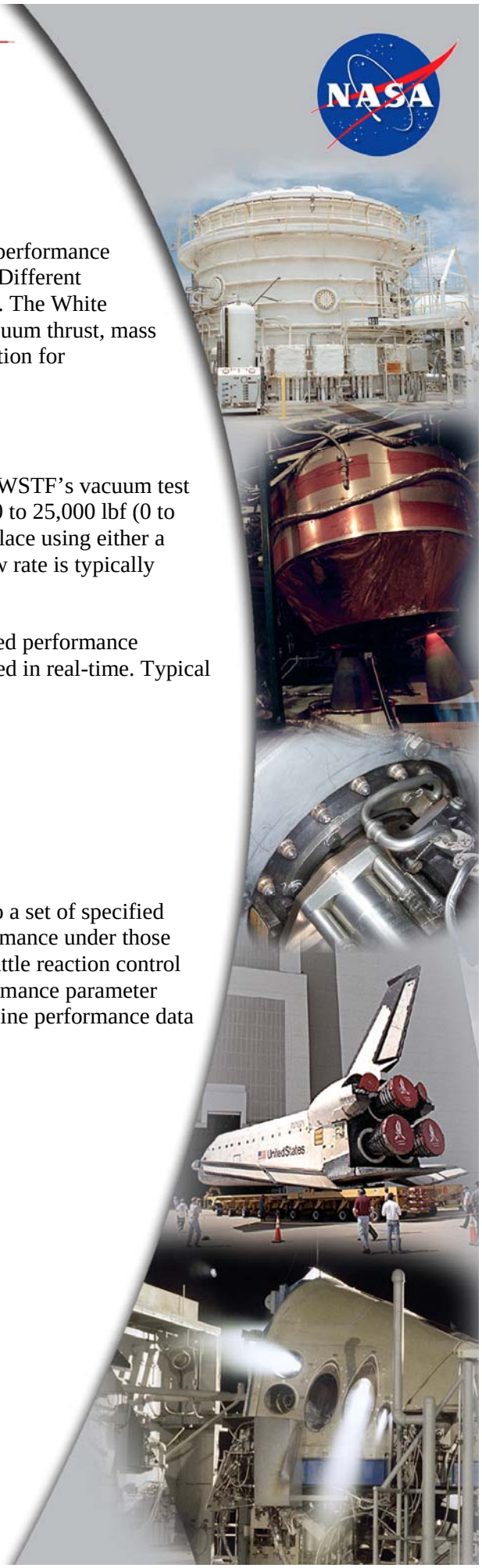
CAPABILITIES

Rocket engine performance measurement can be accomplished in a number of WSTF's vacuum test stands. Vacuum thrust measurement capability currently exists in the range of 0 to 25,000 lbf (0 to 111 kN). Thrust is measured using strain gage load cells that are calibrated in place using either a separate transfer standard strain gage load cell or a dead weight. Propellant flow rate is typically measured using volumetric or mass flow meters.

Along with pressure, temperature, flow rate, and thrust measurements, calculated performance parameters such as specific impulse, mixture ratio, and C* may also be displayed in real-time. Typical 3-sigma measurement uncertainties are as follows:

- Vacuum Thrust: < 1.0%
- FS Mass Flow Rate: 0.2%
- FS Mixture Ratio: < 2.0%
- Specific Impulse: < 2.0%
- C*: < 2.3%

Engine performance parameters may be taken a step further and standardized to a set of specified propellant inlet conditions for comparison to established nominal engine performance under those conditions. This method is currently employed during acceptance testing of shuttle reaction control sub-system engines. A standard inlet condition routine utilizes an engine performance parameter database and the "raw" firing data for a particular engine, and converts raw engine performance data to standard inlet temperature and pressure performance data.

CONTACT

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