ROCKET LABORATORY (RL)

The Rocket Laboratory comprises 10 independent test facilities which perform basic research aimed at developing technologies for current and future space initiatives. Figure 6 shows an aerial photograph of the complex. The following facilities will be described here: (1) Low Thrust Propulsion Facility (Cell 11), (2) Low Thrust Rocket Facility (Cell 21), (3) High Heat Flux Thermal Shock Facility (Cell 22), and (4) Rocket Combustion Diagnostics Laboratory (Cell 32).

Low Thrust Propulsion Facility (Cell 11)

Hydrogen-oxygen thrusters are tested for performance and life in the Low Thrust Propulsion Facility (Cell 11), which is designed to test-fire rocket engines at altitude conditions and thrust levels to 50 lb.

This facility is capable of long-duration test firings at simulated altitudes to 120 000 ft. Cell 11 is shown in figure 7.

The propellants are supplied from gaseous hydrogen and gaseous oxygen tube trailers of 70 000 and 50 000 SCF capacity, respectively. The maximum flow rate of the gaseous hydrogen is 0.022 pps at 1200 psi, and the maximum flow rate of the gaseous oxygen is 0.08 pps at 1000 psi. Air-driven ejectors are used to evacuate the vacuum tank. Test operations are remotely controlled with a programmable logic controller (PLC). The data system can record up to 2500 samples of data per second. A laser is used to perform nonintrusive studies of the rocket engine exhaust plumes.

Low Thrust Rocket Facility (Cell 21)

At the Low Thrust Rocket Facility (Cell 21), research activities include multi-compartment ignition techniques and in situ propellant and metallized propellant performance testing. The facility can be operated at either atmospheric or altitude exhaust conditions at thrust levels up to 100 lb. Cell 21 is shown in figure 8.

Gaseous hydrogen, gaseous methane, gaseous carbon monoxide, RP–1, liquid propane, and metallized propellants can be supplied to the facility. Gaseous oxygen is used as the oxidizer for all testing. A 50 000 SCF gaseous oxygen tube trailer supplies oxygen at a maximum flow rate of 0.10 pps at 1500 psig. Gaseous methane and carbon monoxide are supplied into a manifold system from K-bottle cylinders. The K-bottle capacity is 1200 SCF at pressures up to 1600 psig. Liquid fuel is supplied from eight 1-gal tanks with working pressures to 1500 psig. Metallized propellant fuels are fed to the cell at pressures to 1250 psig. Air-driven ejectors provide altitude capabilities.

A programmable logic controller is used to sequence valve operations. Data capabilities include a high-speed data acquisition system (100 channels) with an overall digitizing rate of 50 000 samples per second and a low-speed data acquisition system (111 channels) with a digitizing rate of approximately 80 samples per second.

High Heat Flux Thermal Shock Facility (Cell 22)

At the High Heat Flux Thermal Shock Facility (Cell 22), research is conducted on ceramic composites, transpiration-cooled seals, thin film thermocouples, and leading edge erosion and oxidation. A 1000-lb-thrust gaseous hydrogen/gaseous oxygen rocket engine is used as a workhorse for testing specimens mounted in the rocket engine exhaust plume. The samples are subjected to temperatures to 5500 °F. The data acquisition systems described for Cell 21 are shared with Cell 22. A programmable logic controller is used to control the test operations. The facility is shown in figure 9.

Rocket Combustion Diagnostics Laboratory (Cell 32)

The Rocket Combustion Diagnostics Laboratory (Cell 32) is shown in figure 10. The cell is currently under construction and will be completed by mid-1993. The facility will initially be used to verify combustion stability models.

The cell is designed for test-firing gaseous hydrogen/liquid oxygen or gaseous hydrogen/gaseous oxygen rocket engines at thrust levels to 2000 lb for short-duration performance characterizations. The propellants systems are supplied from gaseous hydrogen and gaseous oxygen tube trailers of 70 000 and 50 000 SCF capacity, respectively. Liquid oxygen will be supplied from a 50-gal tank with a working pressure of 1800 psig.

Data capabilities include a high-speed data acquisition system (150 channels) with an overall digitizing rate of 600 000 samples per second and a low-speed data acquisition system (111 channels) with a record rate of approximately 80 samples per second. A programmable logic controller is used to control the test operations.

Several ports for optical access are located in the main blast wall which separates the test cell from the laser room. This arrangement will allow the use of laser diagnostic equipment to study complex flow phenomena. A phase Doppler droplet analyzer (PDDA) will measure injector spray droplet size and study velocity characteristics. A laser Doppler velocimeter (LDV) will measure the velocity of droplets and particles in the flow stream. A copper vapor laser flow visualization system will provide qualitative and quantitative flow data. A laser spectroscopy system is planned for the future.

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Space Chemical Propulsion Test Facilities at NASA Lewis Research Center

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