National Aeronautics and Space Administration

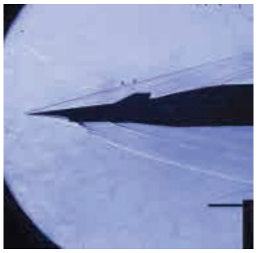
NASA's Aeronautics Test Program

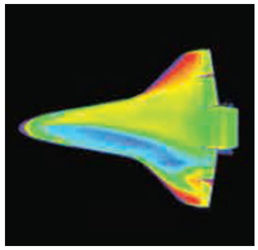
Aerothermodynamics Laboratory

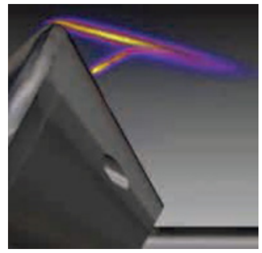
The Langley Aerothermodynamics Laboratory (LAL) is a suite of three hypersonic blow-down to-vacuum tunnels designed for fast-paced aerodynamic and aeroheating studies. These economical facilities are ideally suited for screening, assessing, optimizing and benchmarking advanced aerospace vehicle concepts, as well as performing fundamental flow physics research.

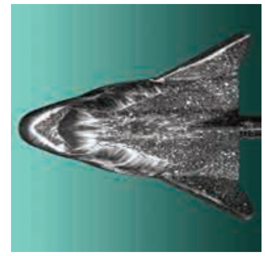
For over five decades the LAL has provided support to commercial, national and international test programs. These facilities have proven indispensable in the development of a wide variety of vehicles including slender body atmospheric flight, manned re-entry and blunt body planetary configurations. The LAL has contributed to most major hypersonic vehicle programs including Apollo, Viking, Space Shuttle Orbiter, Hyper-X and Mars Science Laboratory. These wind tunnels continue to play a critical role in the development of the Multi-Purpose Crew Vehicle, Commercial Crew capabilities and advanced hypersonic technology demonstration vehicles.

In conjunction with experimental capabilities, extensive expertise resides within the LAL team of researchers, test engineers and technicians who provide an interactive and flexible testing atmosphere. Pre-test planning, model design, fabrication, instrumentation, test execution, data analysis and a broad range of computational tools can be customized to meet technical needs.









Facility Benefits

- A wide variety of discrete, global and flowfield measurement tools and test techniques, including two-color phosphor thermography, control jet simulation and advanced laser-based nonintrusive diagnostics, are enhanced by near real time data reduction
- A large selection of five- and six-component force-and-moment balances are available to meet testing needs
- Rapid and inexpensive phosphor thermography model fabrication facilitates efficient and cost effective configuration evaluation of critical phenomena, including peak heating and boundary layer transition
- Standardized instrumentation and data acquisition systems, including high-frequency measurement capability, enable shared-resource utilization and common model/hardware designs
- On-going modifications and upgrades to hardware components and instrumentation are designed to increase capability, reliability and productivity

Facility Applications

- Planetary and entry, descent and landing programs including Mars Micro-probe, Stardust, Genesis, Mars Science Laboratory and Hypersonic Inflatable Aerodynamic Decelerator
- HiFiRE, Hyper-X and other slender body atmospheric flight vehicles in support of military and civilian programs
- Orion Multi-Purpose Crew Vehicle, Ares Launch System and Commercial Crew programs
- Space Shuttle design, Columbia Accident Investigation and Return-to-Flight programs
- Fundamental flow physics research and development of instrumentation and test techniques

Characteristics

Facility	31-in. Mach 10	20-in. Mach 6	15-in. Mach 6
Test gas	Dry air	Dry air	Dry air
Mach number	10	6	6
Reynolds number	0.5 to 2.2×10^6 per ft	0.5 to 8.0×10^6 per ft	0.5 to 6.0×10^6 per ft
Stagnation pressure	350 to 1450 psi (2.4 to 10 MPa)	30 to 475 psi (0.21 to 3.3 MPa)	50 to 450 psi (0.35 to 3.1 MPa)
Stagnation temperature	1850 °R (1011 K)	760 to 940 °R (422 to 522 K)	940 to 1260 °R (522 to 700 K)
Dynamic pressure	0.65 to 2.4 psi (4.5 to 16.6 KPa)	0.51 to 7.6 psi (3.5 to 52.4 KPa)	0.8 to 6.8 psi (5.5 to 46.9 KPa)
Maximum test core size	14 by 14 in. (0.36 by 0.36 m)	14 by 14 in. (0.36 by 0.36 m)	10 in. diam (0.25 m diam)
Maximum run time	120 seconds	900 seconds	120 seconds

Instrumentation

Static Aerodynamics	Force-and-moment strain gage balances
Discrete Pressure	ESP, Druck, Kulite, PCB
Global Pressure	Pressure Sensitive Paint
Discrete Temperature	Thin Film, Thermocouple, Thin Skin
Global Temperature	Phosphor, Infared, Temperature Sensitive Paint
Discrete Heat Flux	Schmidt-Boelter, Atomic Layer Thermopile
Surface Diagnostic	Oil Flow Visualization
Flowfield Diagnostic	Planar Laser-Induced Fluorescence, Schlieren

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