National Aeronautics and Space Administration

Langley Research Center's

Scramjet Test Complex

The facilities of NASA Langley's Scramjet Test Complex - the Direct-Connect Supersonic Combustor Test Facility (DCSCTF) and the Arc-Heated Scramjet Test Facility (AHSTF) - have been conducting hypersonic propulsion research since the 1960's.

The Scramjet Test Complex facilities have the capability to test integrated engines, supersonic combustors, and inlets at simulated flight Mach numbers from 2 to 8.5, and Reynolds numbers from 0.035×10^6 to 6.8×10^6 per foot.

Data from these facilities have been used to improve engine reliability and robustness, to develop control laws for flight research projects and to calibrate and verify Computational Fluid Dynamics codes used to analyze scramjet engine performance.

Upgrades in recent years have improved the performance, reliability, and capabilities. Modifications include PLC-based control systems for both facilities, a 20MW DC power supply, improved fuel and air supply systems, and a liquid fuel system for AHSTF, and max. run time increase of up to 15 minutes for DCSCTF.

The Scramjet Test Complex facilities have made significant contributions to major research programs such as the Hypersonic Research Engine, NASP, and Hyper-X.

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Facility Benefits

- Complementary facilities dedicated to research in hypersonic air-breathing propulsion and related subject areas.
- Different test media and overlapping simulated test condition ranges.
- Fuels include: hydrogen, silane/hydrogen igniter or piloting, and gaseous hydrocarbon mixes.
- PLC-based control systems can control test article components.
- Data acquisition systems and post processing capabilities provide rapid data reduction turn around.

Facility Applications

- The Scramjet Test Complex has made significant contributions to NASA's hypersonic air-breathing propulsion research programs, the NASP Program, Hyper-X (X-43), and HIFiRE.
- All NASP Program major competitors tested their engine designs in these facilities.
- Flow path and propulsion control laws for the Hyper-X (X-43) Mach 7 vehicle, developed with data from the Scramjet Test Complex facilities, enabled the X-43 vehicles to achieve world record performance goals.

Characteristics

Facility	Arc-Heated Scramjet Test Facility	Direct-Connect Supersonic Combustor Test Facility
Test medium	Dry air	Hydrogen-air combustion products with oxygen replenishment
Simulated flight Mach number	2 to 8+	3 to 7.5
Flight Reynolds number, ft^{-1}	$0.035x10^6$ to $2.2x10^6$	$2.0x10^6$ to $8.0x10^6$
Total pressure limit, psia	675 psia	115 to 500
Total temperature, degrees R	2000 - 5200	1600 - 3800
Nozzle Mach number/size, in.	Mach 2.2 - 10.0 by 10.0 in. Mach 6.0 - 10.89 by 10.89 in. Mach 4.7 - 11.17 by 11.17 in. Mach 6.0 - 10.89 by 10.89 in. Mach 6 2D - 10.0 by 10.0 in.	Mach 2.0 - 1.52 by 3.46 in. Mach 2.7 - 1.50 by 6.69 in.
Test time, sec.	120	120 seconds to 15 minutes

Instrumentation

A large pool of instrumentation can be shared among facilities

Six-component strain gage balances
Electronically scanned pressure transducers in a wide array of ranges
Temperature sensors
Heat flux gages
Flow rate meters
Visual access for Schlieren and non-intrusive laser based test techniques

Data Acquisition and Processing

PC based COTS	
Front ends	192-230 Channel A/D multiplexor 512 channel pressure scanner
DAS rate	10-50 Hz
Customer computers	available
High speed DAS	available
Classified capability	Yes

Contact Information

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